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Strengthening an Engine Frame.

BY CHARLES A. HAGUE.

Not long since the writer was asked to examine a vertical steam engine which was threatened with serious breakdown and advise as to the best course to pursue with reference to weakness developing in the bed-plate which promised a complete stoppage of the plant. A new plant of greater capacity was in contemplation, with larger steam power and generally increased facilities, so that it was not considered desirable to buy a new engine, to replace the old one until the new plant should be in operation, as such an engine would not fit in very readily with the new outfit. The engine at work was rather original and certainly antiquated in design, had been in service a good many years, was developing about 200 horse-power and could not be shut down during working hours owing to a brisk demand for product and a disposition upon the part of the owners to take the chances of a breakdown which might not occur rather than make a certain stop at the expense of profits in sight.

The sketch marked Fig. 1 will give an idea of the peculiar form of the engine and the place where the crack began to open up in the bed-plate. The bed-plate consisted of a sort of frame, made of cast iron, resting flat upon the foundations, the nature of its section being indicated in the sketch. The framing of the machine consisted of four cast iron columns, one at each corner of the bed-plate, and supporting an entablature made in halves and upon which the steam cylinder was secured. When the writer first saw the engine at work the swaying of the columns in line with the crank plane seemed rather startling, but it had been going on for several years and the people had become accustomed to what an outsider might consider a sure indication of total destruction within the next ten minutes. The X brace rods of 1¼ round iron fitted with turn buckles, which were found in the storeroom of the factory, were immediately attached to the columns within a day of the inspection of the engine and

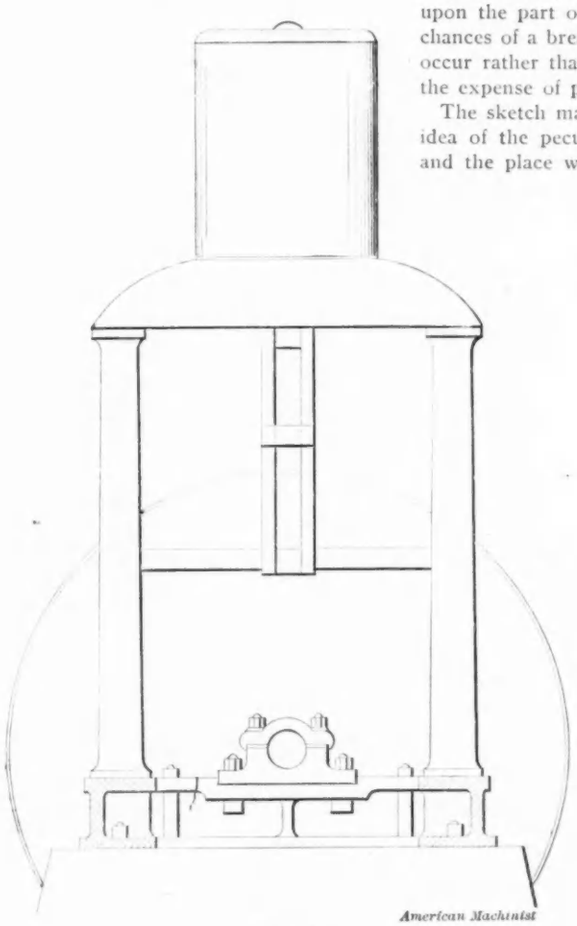

Fig. 1

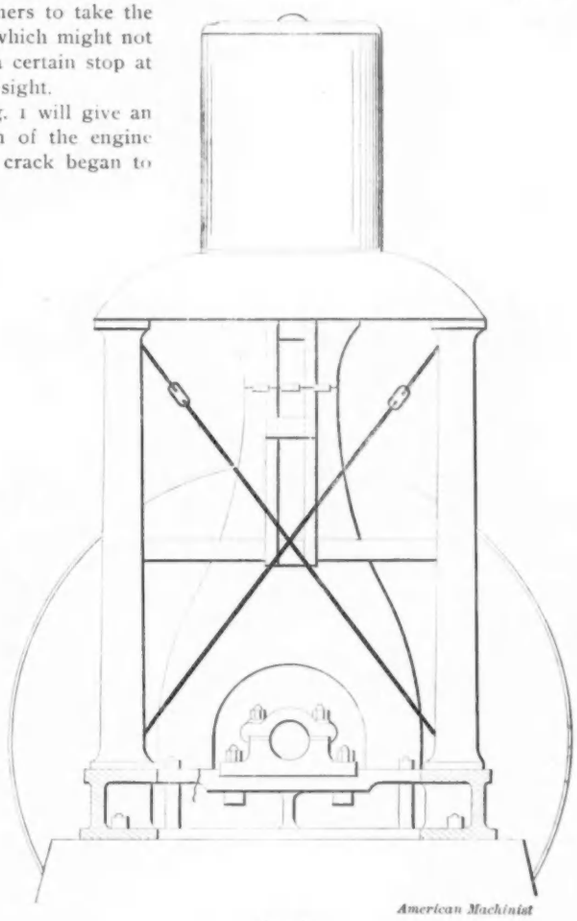

Fig. 2

STRENGTHENING AN ENGINE FRAME.

acted to check to a very great extent the swaying of the machine, and one pair of these braces was left in place after the new strengthening frame had been put in.

Of course it will be seen that an element of weakness was admitted into existence the minute the first drawing was made depicting such a bed-plate and general form of construction. The factor of resistance embodied in the idea of an engine being self-contained is present to a very restricted extent, and beyond quite moderate limits the foundation bolts, weight of the foundations and the actual strength to resist cross straining in the material of the bed-plate came into play in holding out against fracture. For some years, during which the power had been low and the castings new, there had been little cause for worry, although a tendency to spring had been evident from the first turn of the fly-wheel; but as years rolled on and the growth of the business called more and more upon the capacity of the engine increasing distress became apparent, and after a while the crack in the casting came into evidence, as was shown by the action of the oil drippings upon the top of the bed-plate in causing a flicker of light in unison with the revolutions of the engine. After a while longer the fracture became completely revealed, and kept on extending until fears were aroused that ultimate rupture would ensue and then a total stoppage of the engine and factory take place.

After considering the matter it was decided that it would be better to spend some money insuring the durability of the old engine without losing any working time than to attempt to replace it with a comparatively small new engine, or even a second-hand machine, which might find its occupation gone after the new factory had been put into commission.

Fig. 2 will readily show how the difficulty was met, and Figs. 3, 4, 5 and 6 are detail views of the reinforcement. Accurate measurements were taken and drawings made of the middle piece to be applied, and the strengthener was made in two pieces, so as to make it possible to accomplish the work promptly and certainly with the least loss of time consumed after the engine had been shut down for the purpose in view, and after scheming over the matter an hour or two it became apparent that, barring accidents and unforeseeable delays, the time intervening between a Saturday at 5 P. M. and the following Monday morning at 7 A. M. would be sufficient, provided everything was ready. The top of the bed-plate, and the under side of the entablature to which the cylinder was attached, had been planed originally, the surfaces still being in good condition, and therefore we had two parallel faces upon the castings to be held rigidly in relation to each other in the line of strain; the thing to do, then, obviously was to produce a good heavy center frame uniting these two principal members and have it formed so as to straddle the pillow block and incidentally add something to the holding down provisions of the pillow block cap. And, as the placing in position of such a casting, weighing something like two tons, and have it fit snugly in between the bed-plate and entablature, would be a task of promising difficulty and delay, considering the shortness of the allowable time for the work, the idea suggested itself of making the mid-frame in two pieces as shown, bolting each portion respectively to the bed-plate and entablature and then driving between the two portions three flat keys just snugly enough to make all solid, completing the

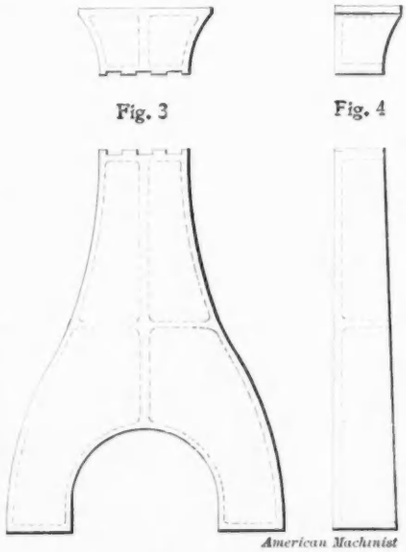

Fig. 3 Fig. 4 Fig. 5 Fig. 6

THE NEW BACKBONE.

rigidity by securely bolting the upper and lower parts together and against the three keys, thus obtaining in effect a solid and continuous mid-frame completely and tightly filling the vertical space as though originally built into the engine. These keys were planed and fitted in the grooves the day before the placing of the frame took place, the keys being left a trifle long, to be dressed flush with the castings afterward.

The bolting was all arranged for in advance, the bolts being made with a nut at each end, so as to facilitate putting into place. All bolt holes necessary to be drilled in the engine were made at night, and also during the daytime, when not interfering with the working of the engine, and were commenced just as soon as the pattern for the mid-frame had been started, as all bolts had been by that time located.

The drawings, patterns and castings were made, the necessary fitting accomplished, the bolts and keys made and the strengthener taken to the door of the engine room in eleven working days from the decision to do the work, and the second day from that being Saturday it was determined to put the frame in place without running the risk of another week with the engine in a dangerous condition.

The stop was made as usual at 5 P. M. on Saturday and the connecting rod, slides (locomotive pattern) and crosshead were removed, the crank pin turned to the lower center and the piston rod secured at its highest position. This was done before the men went to supper at 8 P. M. Arrangements were made for a midnight supper Saturday night, breakfast at 6 A. M., Sunday, and dinner at 12 M., Sunday, and the commissary department having been looked out for the real work commenced. Planking, blocking, chain hoists, jack screws and pinch bars were brought into requisition and at 11:30 the new piece of framing stood upon the top flange of the bed plate ready for bolting, partially secured, and the midnight supper time was at hand. After an hour of intermission, at 1 A. M., the work was resumed and at 3 A. M. all of the lower bolts were adapted to their places and the pillow block cap reinforced. Two hours later the upper portion of the frame was bolted up, the keys fitted and driven up and the bolts joining the two portions put in and set up hard, and by the time the 6 o'clock breakfast hour arrived the new mid-frame was in place and all secured.

As the work had met with no obstruction and was so far advanced, it was thought better to take a little rest, and after breakfast work was not resumed until 9 A. M. Then the putting back of the detail parts of the engine and cleaning up used the time until 1 P. M., dinner being delayed an hour, as it was evident that there was no need of coming back to work again in the afternoon.

The next morning (Monday) the engine was started as usual and went right along with its regular work, apparently innocent of all idea that it had been furnished with a new backbone over Sunday, with all danger of a broken bed plate removed and, in fact, much stiffer and stronger than ever before.

The cost was as follows: Drawings, $10; patterns, $65; castings, $129; fitting up, $86; bolts, keys, etc., $33; putting in place, $36, exclusive of advice and superintendence, making a total as above of $359.

The putting in place was done by two machinists employed in the factory for the regular repairs, who were paid $3 per day, and two laborers, also belonging in the factory, at $1.50 per day. These men were allowed double time for all of the time from 5 P. M. Saturday, until 1 P. M. Sunday, making twenty actual hours, no time being deducted for meals or other stops. This made four working days for each man, and their meals were paid for

by the firm, amounting to $9.50—the will and energy with which these men executed the task in hand affording good evidence of the wisdom of using workmen well at all times and especially when you are in difficulties.

The total of $368.50 was a small outlay for the returns realized, saving the investment in an engine of doubtful utility in the future, to say nothing of the stopping of the factory to put an engine in, all talk of such a stoppage being considered at the time to be the highest kind of treason and not to be thought of for a moment.

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The Strength of Pulley Arms.

BY C. H. BENJAMIN.

For the past two years a series of experiments on pulley arms has been carried on in the mechanical laboratory of the Case School of Applied Science, under the direction of the writer, by Messrs. Parks, Tanner, Krueger and Metlicka, senior students of the school.

FIG. 1.—CAST IRON PULLEY.

FIG.—2. STEEL RIM PULLEY.

The pulleys tested were of three diameters, 16, 20 and 24 inches, and were all of 3½-inch face. The first series of tests was made on cast iron pulleys, cast especially for the purpose by the Walker Company, of this city. One of these is shown in Fig. 1. The second series embraced a set of steel rim pulleys, made by the Medart Pulley Company, of St. Louis, and illustrated in Fig. 2.

The rims of the steel pulleys were ground true when received from the factory, but the cast iron rims were left rough.

In order to represent actual conditions of use as far as practicable the pressure was applied to the rims of the pulleys through the medium of a steel belt and the arms broken by the torque thus obtained.

Figs. 3 and 4 show the manner in which this was done. Referring to Fig. 3, the pulley was mounted on a mandrel *M* of octagon steel, this latter fitting corresponding recesses in the cast steel standard *S* so as to prevent any turning of the pulley relatively to the standard.

The standard was bolted rigidly to the arch *A* of a Riehlé 60,000 pound testing machine, and a belt *B* of spring steel ⅛ inch thick and 3½ inches wide, was then hung on the pulley and prevented from slipping by wooden clamps, as shown in Fig. 4.

A system of weighing levers *L L'* permitted the downward pull of the crosshead *C* to be applied in such a way that the relative pull on the two sides of the belt could be adjusted in any way desired.

The pressure of *C* was transmitted through the knife edged piece *K* to the lower lever *L'*, which rested at one end on an outer support and at the other on the hanger *H*.

This in turn transmitted a part of the pull to the upper lever *L*, through the hanger *H*, and at the same time divided the pull between the two sides of the belt in any desired ratio. In the experiments to be described the ratio adopted was that of two to one.

This ratio gives a comparatively large crushing force on the pulley in proportion to the torque, and was chosen partly for that reason and partly because it is quite a common ratio in actual practice.

The sum of the tensions on the two sides of the belt was thus transmitted through the arch *A* to the weighing platform *P* and thence to the beam of the machine. To find the net or turning pressure on the pulley rim it was thus necessary to divide the scale reading by three.

To measure the bending or deflection of the arms a simple multiplying lever was used, as shown in Fig. 5. The collar *C* was attached to the hub of the pulley and adjusted by the set screws shown. From this collar projected three rigid arms *A A*. At the extremity of each arm was pivoted a lever *L*, the outer end of the lever being moved by a small pin inserted in the rim of the pulley. The inner pointed end of the lever traversed a scale marked on the collar *C*.

No effort was made to do very exact work with this apparatus, the only object being to determine the comparative bending of arms at different parts of the circumference. On the steel pulleys a compound lever was used.

Table I. shows the dimensions of the cast iron pulleys tested and Table II. those of the steel pulleys. The arms on all the pulleys were nearly elliptical in section and slightly tapering, as may be seen from the cuts. The record of the weights of most of the cast iron pulleys has unfortunately been lost, but they were usually a third heavier than the corresponding Medart pulleys. The 20 and 24 inch Medart pulleys were of two weights, intended for single and double belts respectively.

Strength of Metal.—As all the pulleys tested were made especially for these experiments it was possible to have test bars cast at the same time and from the same ladle of iron. The test pieces were all 12 inches between supports, and of cross-sections approximately the same as the respective pulley arms. They were broken transversely in the testing machine.

Seven test pieces from the cast iron

pulleys gave an average modulus of rupture: $S = 35{,}830$.

Four test pieces from the metal used in the arms of the Medart pulley gave an average modulus of rupture: $S = 50{,}800$.

The latter bars showed a very close-grained gray fracture, but more like cast iron than cast steel.

The Experiments.—Each pulley in turn was put in the testing machine, the deflection instrument attached and pressure gradually applied. Readings of deflections were taken at regular intervals extending nearly up to the point of rupture. In every instance the arm nearest the tight side of the belt (*i. e.*, the side having the greater pull) showed the greater deflection and broke first.

The arms of the cast iron pulleys broke usually at the inner end near the hub (see Fig. 1), occasionally at the outer end and sometimes at both ends simultaneously.

In one instance, No. 9, the hub of the pulley broke through from side to side.

The arms of the steel pulleys all broke at the inner end.

As may be seen in Fig. 1, the arms of the cast iron pulleys usually separated after fracture, showing a condition of initial stress due to shrinkage. The pulleys were arranged in different positions, with one arm vertical, with one arm horizontal, etc., but the general result was always the same, the arm nearest the greater pull failed, sometimes two simultaneously. The buckling and springing of the rim was easily observable, especially with the steel rims, and accounts for the fact that the stress was not divided evenly between the arms.

In Tables III. and IV. are given the results of the experiments. In each table the third column gives the scale reading or total load and the fourth column the net force producing the turning moment. The sixth column gives the total moment at the inner end of arm due to P.

An examination of the values of W in Table III. will show that the different sizes of pulleys are well designed, as there is but little variation in the breaking load. Furthermore it will be seen that the taper of the arms is about right, since nearly as many broke at the outer as at the inner end.

In the case of the Medart pulleys the break was always at the end next the hub. This shows that on account of the limberness of the rim and the manner of fastening it to the arm, the latter receives little support at the outer end and bends almost like a cantilever fixed at the hub. There is also more variation of strength in the Medart pulleys.

The deflections of the arms in the cast iron pulleys were small, varying from three to seven hundredths of an inch under loads approximating that of rupture. For instance, in the test of pulley No. 7 at a total load of 11,000 pounds, the arm nearest the tight side of belt showed a deflection of .062 inch, while an arm on the other side was only deflected .011 inch.

The deflections of the steel pulley arms varied from .02 to .10 inch.

Theory of Pulley Arms.—Many of the formulas proposed for pulley arms assume two things, neither of which is true; first, that the load is evenly distributed among the arms; second, that the arm bends like a cantilever or bracket fixed at the hub and free at the outer end. No ordinary pulley rim is rigid enough

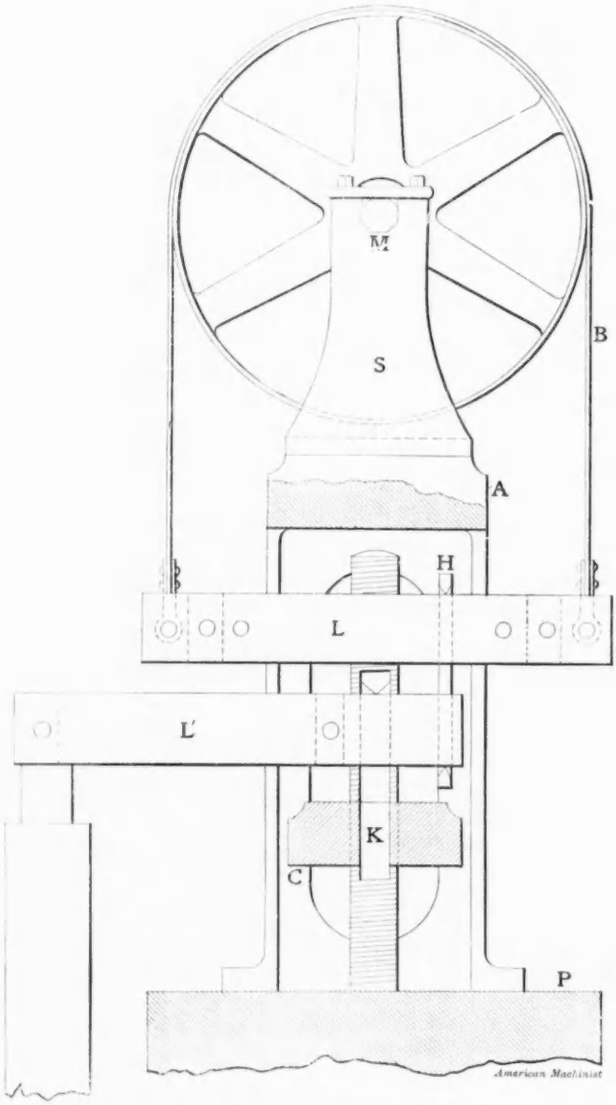

FIG. 3.—MANNER OF LOADING THE PULLEY.

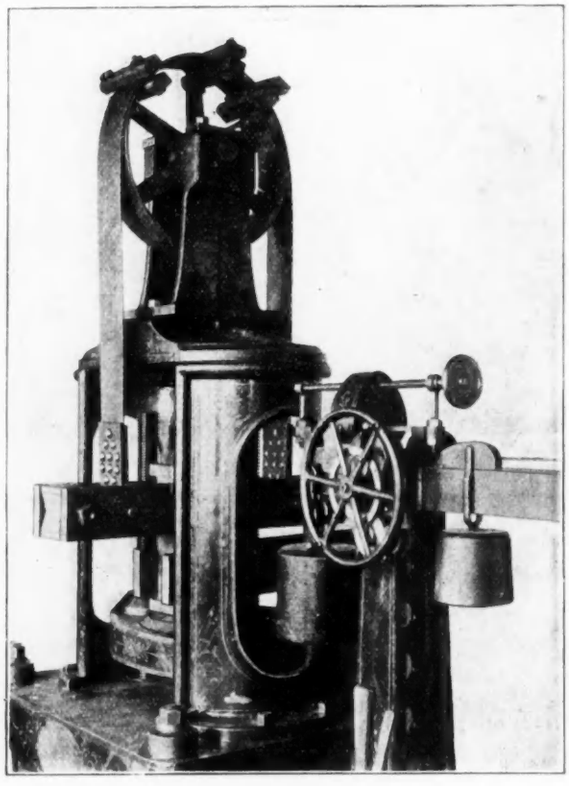

FIG. 4.—TESTING MACHINE AND PULLEY IN PLACE.

to transmit the force uniformly to the various arms, while on the other hand it is rigid enough to exert a very appreciable bending moment on the outer ends of the arms.

When the pull of a belt is applied to the rim of a pulley, each arm bends in one direction at the hub and in the opposite direction at the rim, tending to assume the shape of a letter S. There were several good illustrations of this among

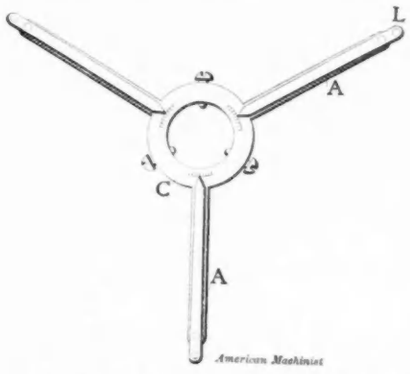

FIG. 5.—METHOD OF MEASURING THE DEFLECTION.

the pulleys tested. Pulley No. 1, as shown in Fig. 6, broke simultaneously at both ends of the arm, but on the upper edge of the hub end at *A* and the lower edge of the rim end at *B*. These were the edges which were in tension when the load was applied as shown by the arrow.

It is comparatively easy by the aid of the higher mathematics to determine the bending moments at each end of a pulley arm if it is straight and of uniform size, but as very few pulley arms are of uniform section, it is hardly worth the while to do so here. Suffice it to say that the greatest bending moments on an ordinary pulley arm are at the two ends and that the bending moment of the hub is always the larger of the two.

The results in Table III. show this very clearly, for while the arms were much stronger at the hub they usually broke there. The amount of negative bending at the rim depends on the stiffness of the rim, *i. e.*, on whether the outer end of the arm remains radial when the pulley springs.

In the case of the Medart pulleys the rim yielded so much that there was comparatively little bending of the arm at that end and all the arms broke at the hub.

Now the combined bending moments of all the arms together resist the total moment given in the tables, but this latter moment is not divided evenly among the arms.

One object of this investigation was to find what portion of the total moment was carried by the arm which broke.

If we let:

S = modulus of rupture of metal,

I = moment of inertia of section,

c = half depth of section,

then will $\frac{S\,I}{c}$ = the moment of resistance of the section of arm at rim or hub, as the case may be. Comparing this with the total moment exerted will give the desired ratio.

Tables V. and VI. have been constructed to illustrate the application of this principle. S is taken from the results of the experiments on the test pieces. I is given in Tables I. and II.

Cast Iron Pulleys.—Referring first to Table V., containing the results for this species of pulley. It will be seen from the fourth and fifth columns that the arms were approximately twice as strong at the hub as at the rim. That this proportion is about right is apparent from the fact that some of the arms broke at one end and some at the other. The third column in the table is taken from Table III. and is the moment obtained by multiplying the net pull on the rim by the length of arm outside of the hub plate. Dividing this moment by the resisting moments of the arms at inner and outer ends gives the ratios in the two last columns. Some variation was to have been expected since cooling strains were doubtless present in all the wheels. Each of these pulleys had six arms.

We may, then, adopt the following rules to guide us in the design of cast iron pulley arms similar to the above:

1. Multiply the net pull of belt by a suitable factor of safety and by the length of arm in inches. Divide this product by one-half the number of arms and use the quotient for a bending moment. Design the hub end of arm by the usual rules to resist this moment.

2. Make the rim ends of arms one-half as strong as the hub ends.

Steel Rim Pulleys.—In Table VI. only

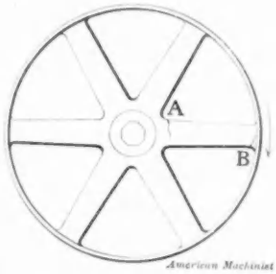

FIG. 6.—SHOWING NATURE OF STRAINS IN PULLEY ARMS.

the hub ends of arms have been considered, since the arms all broke at that end. The reasons for this have been already explained.

It is apparent that the arms in these pulleys might have been made more tapering without impairing their strength. Furthermore that the arms are weakened considerably by the failure of the rim to stiffen the outer ends.

The pulleys numbered 15, 16, 19 and 20 were heavier than their mates and correspondingly stronger. There was, however, more variation in strength than among the cast iron pulleys. Whether this was due to variation in the quality of metal or in the construction of the pulleys the writer is unable to say. There were no evidences of shrinkage and after the pressure was removed the fractures closed up and became almost invisible.

To test the metal still further, uninjured arms were cut from some of the pulleys and broken transversely in the testing machine. The values of $\frac{S\,I}{c}$ obtained in this way are the ones used in the table and are about 4 per cent. less than those obtained from the test pieces.

An examination of the ratios obtained for the 20 and 24 inch pulleys show that our Rule 1 will apply fairly well to this type of pulley. The results in the case of the 16-inch pulleys were too irregular to reduce to rule.

General Conclusions.—1. That the bending moments on pulley arms are not evenly distributed by the rim, but are greatest on the arm near the tight side of belt.

2. That there are bending moments at both ends of the arm, that at the hub being much the greater, the ratio depending on the relative stiffness of rim and arms. An increase of the width of rim will undoubtedly help the arms.

3. It is necessary to make other experiments with different numbers of arms and with different ratios of belt pulls before formulating general rules for belt pulleys.

No.	Diameter. Inches.	Number of Arms.	Moment of Inertia of Arms. Outer End.	Moment of Inertia of Arms. Inner End.	Diameter of Hub Plate.	
5	24	6	.187	.505	?	
6	24	6	.187	.505	?	
7	24	6	.187	.505	?	
8	24	6	.187	.505	?	
1	20	6	.123	.370	6.4	
2	20	6	.123	.370	6.4	
3	20	6	.123	.370	6.4	
4	20	6	.134	.402	6.4	
9	16	6	.097	.229	5.8	Weight of 16 in. pulley 29 lbs.
10	16	6	.097	.229	5.8	
11	16	6	.097	.229	5.8	
12	16	6	.097	.229	5.8	

TABLE I.—CAST IRON PULLEYS.

No.	Diameter. Inches.	Number of Arms.	Moment of Inertia of Arms. Outer End.	Moment of Inertia of Arms. Inner End.	Diameter of Hub Plate.	Weight of Pulley. Lbs.
13	24	8	.012	.045	5.5	29
14	24	8	.017	.038	5.5	29
15	24	8	.028	.070	5.5	34
16	24	8	.031	.079	5.5	33
17	20	8	.016	.034	5.	26
18	20	8	.018	.032	5.	26
19	20	8	.027	.053	5.	29
20	20	8	.032	.064	5.	29
21	16	6	.021	.032	4.5	20
22	16	6	.020	.026	4.5	21
23	16	6	.022	.034	4.5	21
24	16	6	.025	.029	4.5	21

TABLE II.—MEDART PULLEYS.

No.	Diameter.	Total Load W.	Turning Press. $\frac{W}{P=3}$	Length of Arm. Inches.	Total Moment. Lbs. ins.	Location of Break on Arm.
5	24	13800	4600	8.5	39100	Outer.
6	24	15100	5030	8.5	42700	Both.
7	24	13600	4530	8.5	38500	Inner.
8	24	18100	6030	8.5	51200	"
1	20	13100	4370	6.8	29700	Both.
2	20	13500	4500	6.8	30600	Inner.
3	20	14200	4730	6.8	32200	Both.
4	20	18300	6100	6.8	41500	Inner.
9	16	12800	4270	5.1	21700	Hub.
10	16	16200	5400	5.1	27700	Inner.
11	16	15300	5100	5.1	26000	"
12	16	21800	7270	5.1	37100	Both.

TABLE III.—CAST IRON PULLEYS.

No.	Diameter.	Total Load W.	Turning Press. $\frac{W}{P=3}$	Length of Arm. Inches.	Total Amount. Lbs. ins.	Location of Break on Arm.
13	24	4500	1500	9.25	13900	Inner.
14	24	3600	1200	9.25	11100	"
15	24	7100	2370	9.25	21900	"
16	24	6200	2070	9.25	19100	"
17	20	7350	2450	7.5	18400	"
18	20	7500	2500	7.5	18700	"
19	20	6900	2300	7.5	17200	"
20	20	9600	3200	7.5	24000	"
21	16	2800	930	5.75	5350	"
22	16	3900	1300	5.75	7460	"
23	16	2900	970	5.75	5570	"
24	16	5200	1730	5.75	9950	"

TABLE IV.—MEDART PULLEYS.

No.	Diameter.	Total Moment. M.	Moment of Resistance of Arms $\frac{S\,I}{c}$		Ratio $M \div \frac{S\,I}{c}$	
			Hub End.	Rim End.	At Hub.	At Rim.
5	24	39100	14950	7100	2.62	5.50
6	24	42700	14950	7100	2.86	6.01
7	24	38500	14950	7100	2 58	5.42
8	24	51200	14950	7100	3.42	7.20
1	20	29700	13400	6300	2.22	4.71
2	20	30600	13400	6300	2.28	4.86
3	20	32200	13400	6300	2.40	5.11
4	20	41500	11600	5100	3.58	8.15
9	16	21700	8050	4250	2.70	5.10
10	16	27700	8050	4250	3.44	6.52
11	16	26000	8050	4250	3.23	6.11
12	16	37100	8050	4250	4.61	8.73

All 6 arm pulleys = averages 3.00 6.12.

TABLE V.—CAST IRON PULLEYS.

No.	Diam.	Total Moment M	Moment of Resistance of Arms at Hub $= \frac{S\,I}{c}$	Ratio $M \div \frac{S\,I}{c}$	
13	24	13900	3840	3.62	Average for Eight Arm Pulleys = 4.4.
14	24	11100	3340	3.33	
15	24	21900	5300	4.14	
16	24	19100	5750	3.33	
17	20	18400	3150	5.84	
18	20	18700	3030	6.17	
19	20	17200	4320	3.98	
20	20	24000	4980	4.81	
21	16	5350	2940	1.82	Average for Six Arm Pulleys = 2.5.
22	16	7460	2610	2.86	
23	16	5570	3150	1.76	
24	16	9950	2720	3.65	

TABLE VI.—MEDART PULLEYS.

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Some Points in Gas Engine Design.

BY JOSEPH B. HALL.

In designing a gas engine recently the writer incorporated some improvements which may be worth noting.

The engine is of the two cycle type, wherein a single cylinder is employed to alternately inspire, compress, explode and exhaust the charge of gas and air. Its appearance is generally similar to others of the vertical inclosed self-oiling style. Excepting the piston, valve and wrist pin, lubrication is effected by the throw of the crank into a bath of oil partly filling the crank case, which splashes the oil everywhere in the case. The valve is lubricated by a sight feed oiler and the wrist pin by a device consisting of a tube fastened to the edge of the connecing rod terminating at the bottom in a hollow cone, which dips in the oil each revolution, causing it to spurt up and out at the top of the tube, the stream being directed against the wrist pin and box, which are deluged.

The usual spring closed poppet valves are dispensed with and a single counterbalanced piston valve substituted, which requires but little power to operate, permitting a quick opening and closing of ports to be obtained. The cam used to operate valve is of large diameter with side groove in which a roller upon the valve stem engages. This cam rotates on the shaft, having an internal gear which is rotated through an idler gear by a shaft gear, reducing the speed of cam to one-half of that of shaft. This combination is the most compact obtainable, and with the small power consumed is quite efficient.

On small sizes of gas engines trouble is sometimes experienced in starting by reason of leakage occurring past the cylinder rings, so much so that at times sufficient compression cannot be had to explode the charge. This is obviated by placing soft packing at the bottom of the trunk piston, where there is no likelihood of it charring from the cylinder's heat. A screw ring is used to keep it tight.

Governing is effected by automatic cut off, whereby the charge is admitted during a portion of the intake stroke and then cut off, permitting the mixture of gas and air to expand until that stroke is completed, it being compressed upon the return stroke. This method is excellent for light loads, for the mixture of gas and air remains constant. But when the charge is throttled—as is the customary method of governing—the mixture of gas and air cannot help but vary in composition, and when a carburetter is used the air, when passing slowly through the volatile oil (benzine, naphtha, etc.), has a tendency to form a richer mixture than when the engine is at full load and the air passes more rapidly.

The carburetter employed is very simple, but efficient. Alongside of the valve chamber and connecting with it is the carburetter, inclosed in the engine case. It is a wire grid, upon which is stretched numerous folds of muslin, kept constantly wet with the volatile oil. This muslin is folded sideways, so that, while no layers are in contact, several square feet are contained in a few cubic inches. The air passing between the layers impinges upon the cloth and absorbs a certain amount of the liquid as vapor, proportionate to the speed of the air and the area of the saturated cloth. No rich mixtures can be better obtained in any other way, except by heat, and this method has the advantage that a minimum quantity of the oil is exposed to the action of the air, thus lessening the fire risk.

A modification of the above could be obtained by causing the air to pass directly through the saturated muslin, but this has a tendency to cause the oil to form a fine mist, which does not thoroughly mix with the air, and which will, upon explosion, deposit soot on the cylinder walls.

Auburn, N. Y.

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Our Growing Export Trade in High Grade Mechanical Products.

An especially gratifying feature of our machinery export trade is that it consists so largely of high grade products. Not only is there a large and growing trade in all the best machine tools, but the best products of these tools seem to be the things most appreciated and sought for abroad. The list includes telephones, telegraph instruments, typewriters, bicycles, locomotive and other steam engines, shoe machinery, electrical machinery in great variety, sewing machines, printing presses, scientific instruments, pianos, clocks, watches and such things to the value of $50,000,000 for the year just ended. The following table, compiled by the Treasury Bureau of Statistics, shows the distribution of three of our important mechanical products:

	Typewriters.	Bicycles.	Sewing Machines.
United Kingdom..	$896 575	$1,852,166	$879,650
France.....	94 608	482,680	102,824
Germany.....	425,614	1,724,404	861,687
Other Europe.....	232,253	949,502	211,643
British N. America	51,752	614,003	141,222
Mexico.....	28,900	68,022	197,642
Central America..	2,360	8,267	30,312
West Indies.....	5,837	98,137	24,658
South America....	42,072	253,361	356,802
Asia and Oceanica.	85,900	596,912	319,200
Africa	30,342	197,365	10,556
Other countries...	....	1,710	150
Total.....	$1,902,153	$6,846,529	$3,136,364

This is vastly better than shipping pig iron or cotton or wheat, as it represents the work of the highest-priced or best paid workers in the world.

A Counterboring Lathe.

BY A. H. CLEAVES.

As a supplement to the drilling tool which I recently described, I will contribute a special device for counterboring without marring fine work. This tool gages the hole in the work by the surface of the work, giving the same depth of sink with any thickness of material.

In Fig. 1 *A* is a sliding headstock, with binding bolt nut and washer *J*, the bolt passing through the opening *D* in the lathe bed and binding underneath. This headstock has divided bearings, owing to the shape of the piece *R*.

The footstock *B* is held with the short bolt *I* in the *T* slot in *D*. The drill plate *C* is held by *G*, a clamp ring or loop drawn tight by the nut *H*. This piece fits a slot in *B* and has a hole in it through which the drill plate rod passes. It has a shoulder, and threaded end for *H*, which rests on *B* each side of *G*, for tightening spindle on drill plate *C*.

The yoke *R* has a space for the pulley *K*, and is kept from revolving by the pin *T* in the slot on the under surface of the yoke. This yoke carries at the front end a steel shell *S*, held securely with two or three set screws. The spindle *Q* and yoke *R* slide together, *Q* revolving in *R*. The counterbore is regulated with a stop collar *M*, and another collar *L* for adjusting the depth of bore. The counterbore is tried, and when deep enough the point of *S* is brought up to the face of the work while the counterbore is in the hole. Then the collar *M* is brought up to *L* and set, when *L* can be moved either way to change the depth of the sink. The handle *O* and *N* has been described in another paper.

The spindle *B* not revolving, the end of *S* comes against the work without marking it. *E* and *F* are pedestal and bench bolt respectively.

Chicago, Ill.

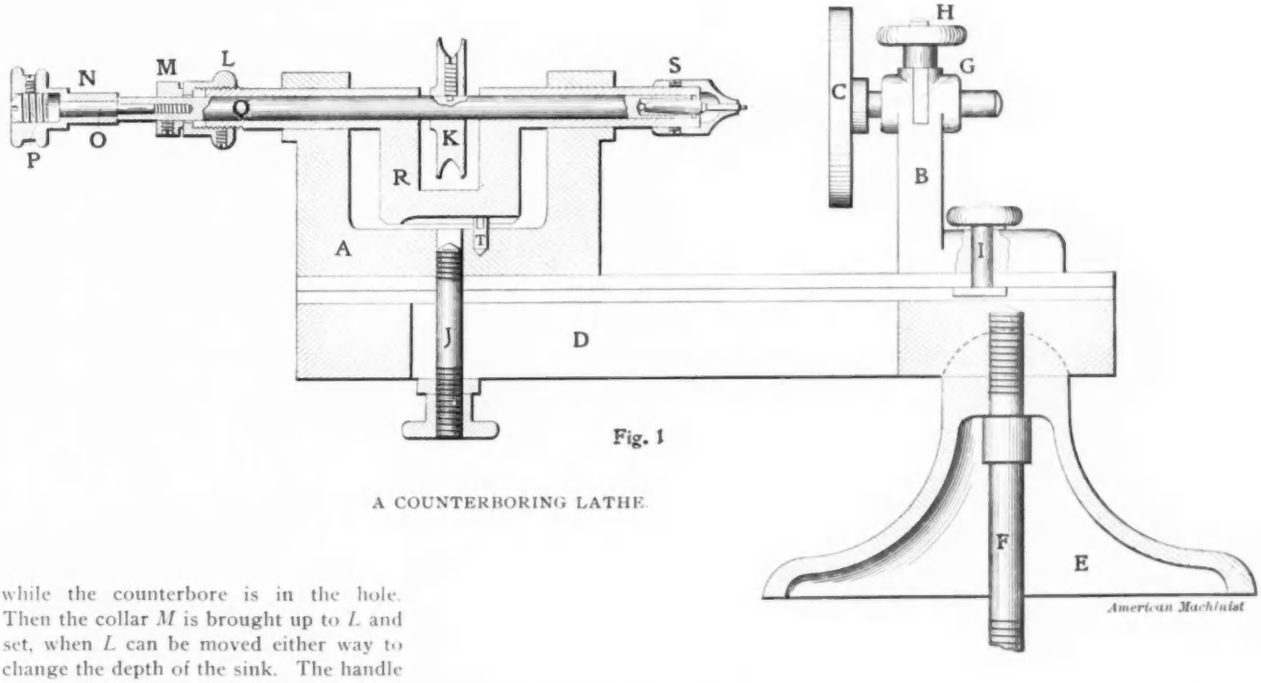

Fig. 1

A COUNTERBORING LATHE.

Alloys for Bearings.

A very interesting paper on "The Micro-Structure of the Bearing Metals" is printed in the August issue of the journal of the Franklin Institute. It is by Guilliam H. Clamer, chemist to the Ajax Metal Company, of Philadelphia, Pa. He draws the following conclusion from his investigations: Of all metals lead is by far the first in anti-friction qualities, and if to the strength of copper and tin there is added a suitable proportion of lead, thoroughly and evenly distributed throughout the mass, the bearings as they wear are constantly in contact with soft anti-friction particles of lead, which are backed by the harder particles of copper and tin. If in such an alloy the lead is not homogeneously distributed and without liquation, both the bearing and anti-frictional qualities are greatly affected. After going through the whole subject of the composition of metals suitable for bearings, the thoroughly homogeneous alloy of the proper proportions of copper, tin and lead seems, he states, to be the best suited for the purpose, and this has also been demonstrated in actual service by the use of such an alloy on all record-breaking trains of recent years, notably the New York Central & Hudson River flyer from Albany to Buffalo, which made the run of 436½ miles in 407 minutes, with the bearings perfectly cool throughout the entire run, and on the fleetest ocean greyhounds that cross the ocean. The alloy of copper, tin and lead, of proper composition and homogeneous structure, has greater anti-frictional qualities than any other composition of sufficient strength to be used as a journal brass in railroad service. This fact has been demonstrated several times by actual practical tests, and, furthermore, the alloy does not deteriorate in remelting.—"Engineering."

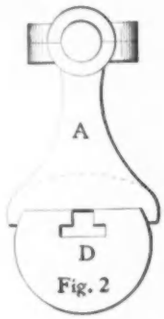

Fig. 2

Fig. 3

HEADSTOCK OF LATHE.

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The exhibition department of the Philadelphia Bourse has been improved of late, and we are informed that the number of visitors seen there is much greater than formerly.

A New Boiler Feed Regulator and Steam Trap.

The accompanying cuts show the construction of a new boiler feed regulator and a steam trap possessing valuable features, of which perhaps the most striking is simplicity. In each a float is employed and the float merely raises and lowers, or opens and closes, a double-seated, balanced poppet valve, this valve in the feed regulator, Figs. 1 and 2, admitting and shutting off the steam from a duplex feed pump or other feeding device as required, and in the steam trap, Fig. 3, a similar valve opens and closes the passage by which the water is discharged. A striking feature in each apparatus is the device for keeping the float always empty, it being a familiar experience that such floats are very apt, under pressure and in contact with the water, to allow more or less water to leak in and accumulate in the float and eventually to sink it and render it useless. In the steam trap the float, with the valve as a part or continuation of the stem below it, is the only moving part. The float is spherical and made of copper; the stem is hollow, forming a passage from the interior of the float to that portion of the stem which is between and connects the two valve faces, where some cross holes perforate the stem. When the float is down the valve is, of course, closed. When the float rises, in consequence of the accumulation of water in the chamber, the water flows down past the upper valve face and up past the lower valve face into the central passage, by which it flows away. As the interior of the float is always in free communication with this passage, by the hollow stem mentioned, it is impossible for water to accumulate within it.

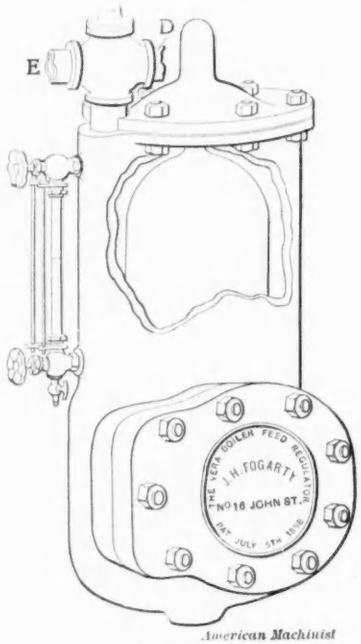

Fig. 1

THE "VERA" BOILER FEED REGULATOR.

In the boiler feed regulator a similar hollow copper float is employed. The float has a guide stem at the top, and the stem *B* below connects with the lever *A*, which operates valve *C*, the leverage giving the valve a reverse movement to that of the float. The flexible copper tube *D* connects the interior of the float and its hollow stem with an opening in the side of the shell, by which any water that may leak into the float is at once discharged. The tube yields with sufficient freedom to cause no interference with the vertical movement of the float. It will be seen that the devices described are about as simple as could be desired. They are made by James H. Fogarty, 16 John street, New York.

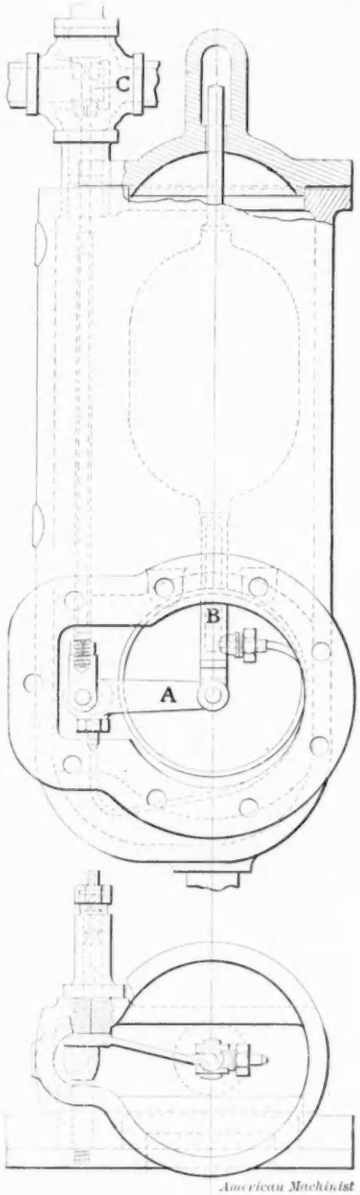

Fig. 3

DETAIL OF FEED REGULATOR.

Instruction in Electricity.

We have received from Prof. A. J. Rowland, of the Drexel Institute of Art, Science and Industry, Philadelphia, circulars containing full information regarding the evening classes in electrical engineering and applied electricity conducted by that institution. These courses are intended to bring the opportunities offered by the institute within the reach of those unable to attend by day. In the electrical engineering course no effort is made to graduate electrical experts; nevertheless, there is a constant endeavor made to give students a thorough and practical knowledge of constructive as well as experimental engineering. The course in applied electricity is intended for men who have not time on their hands to devote to the study of mathematics and physics, and is designed to prepare them for operating electrical plants, etc. The examinations for admission to the courses are simple, and for those anxious to add to their knowledge without abandoning daily employment present a good opportunity. Sessions in both subjects begin October 3, 1898, and continue until March 31, 1899.

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Rochester Athenaeum and Mechanics' Institute.

We have received a circular of information of the above institution, which includes departments of industrial and fine art and of domestic science. The instruction given in the department of industrial and fine art includes artistic, mechanical and architectural drawing, clay modeling and manual training, full courses under these heads costing $75 per year. The institution appears to be a very flourishing one, having had an attendance of over 1,800 pupils last year. It is supported to a large degree by voluntary contributions from the citizens of Rochester.

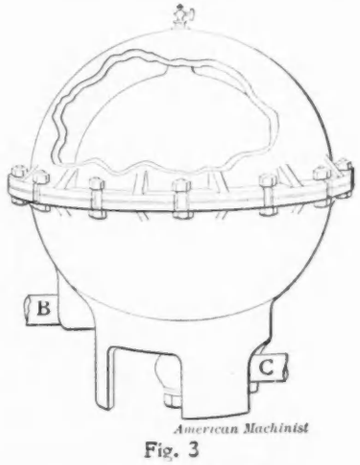

Fig. 3

THE "VERA" STEAM TRAP.

A New Transmission Dynamometer.*

BY WILLIAM ERNEST DALBY, M.A., B.SC., ASSOC. M. INST. C. E.

Many transmission dynamometers have been constructed in which the deformation of a spring is used to measure the work transmitted. Their mechanism may be divided into two distinct parts: (1) The measuring springs and the apparatus fixing them to the several parts of the dynamometer; (2) the apparatus used to measure the deformation of the spring. It is of a new mechanism for the latter purpose that this paper particularly treats.

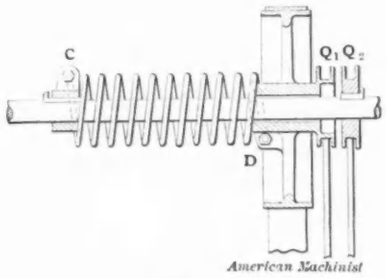

Fig. 1

PRINCIPLE OF DYNAMOMETER.

The problem presents itself in the following form: One end of a spring, Fig. 1, is fixed to the shaft at C and the other end is fixed to the loose pulley at D. Consider the shaft as driving a machine through the spring, pulley and belt. A turning moment applied to the shaft twists the spring, until the applied twisting moment is equal to the resisting moment at the pulley. Then the pulley and shaft may be turned together without relative angular displacement. If there be any change in the moment of resistance at the pulley there must be a corresponding change in the applied turning moment, and the spring twists or untwists until the equality of the two moments is established. The torque is proportional to the relative angular displacement of the ends of the spring, and the special problem is to measure this displacement when the spring is rotating. This is the same thing as measuring the relative angular displacement of the pulley and the shaft, since one end of the spring is fixed to the pulley and the other end to the shaft. To do this let two grooved pulleys Q_1 Q_2, of exactly the same diameter, be fixed, one to the pulley and the other to the shaft (in Fig. 1, Q_1 is shown cast with the pulley). Place over these pulleys an endless steel band in such a way that there are formed two hanging loops, the parts of the band forming one loop leading one to the pulley Q_1 and the other to the opposite side of the pulley Q_2, as shown in Fig. 2. The band is placed over the pulleys Q_1 Q_2 in the same way as the endless chain is put over a pair of Weston differential pulley blocks. However quickly the pulleys may be rotating, so long as there is no relative angular displacement between them the distance apart of the loops will remain the same; for one pulley winds on just as much band as the other winds off. The slightest relative angular displacement of the pulleys alters the distance between the loops, for then the quicker pulley is winding on more band than the slower one winds off. If a guide pulley be placed in each loop, suitably constrained to move in a slide to avoid lateral oscillations, the distance apart of the loops may be easily measured by attaching a point or index to the frame of one guide pulley, arranged to read against a scale attached to the frame of the other.

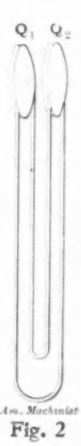

Fig. 2

PRINCIPLE OF REGISTER.

A dynamometer constructed according to the foregoing principles has been erected in the Engineering Laboratory at Cambridge. A dynamometer pulley was substituted for an ordinary pulley on the main shaft and drove a dynamo; the shaft was driven by a high-speed gas engine at 500 revolutions per minute. The pulley was mounted on ball bearings to minimize the friction between it and the shaft. To prevent the band from creeping or slipping, the pulleys Q_1 Q_2 are sprocketed and the steel band is correspondingly punched. The length of the endless band is adjusted so that the measuring apparatus may be placed in a position convenient for observation. Guide-pulleys were placed in the hanging loops and their weights keep the bands taut. A steel rule was attached to the frame of the upper pulley, and a point or index to the lower pulley to observe the change in the distance between the pulleys. A calibration must be made for any particular spring, so that the value of the scale divisions may be interpreted in foot-pounds.

As the loops lengthen or shorten, the frames carrying the pulleys must slide up and down quite freely, and without side shake. For if one loop shortens, the other lengthens by the same amount, and the pulley only keeps in touch with the lengthening loop by virtue of its weight. Consequently a tendency to stick at any point would prevent its following the loop, and would impair the scale readings. To give this sliding freedom, combined with a good fit, a kinematic slide has been devised. The slide-bars are formed of three turned rods held together by suitable end-plates, so that they form a rigid frame of three parallel bars. The frames carrying the guide-pulleys slide on these bars. Each frame touches the bars at six points only; the rigid portion of the pulley frame having five points of constraint, and therefore one degree of freedom, while a spring contact at the sixth point furnishes the necessary pressure against the five points of constraint. Fig. 3 shows one of the frames used in the measuring apparatus of the dynamometer referred to above. It carries an arm A_1, each end of which is formed into a V-groove, V_1 V_2. If the frame is held against the bar, so that these V-grooves rest on it, there is contact between the bar and the frame at four points only, viz., one point in each face of each groove. The faces are rounded slightly to ensure this. The frame has now two degrees of freedom, viz., a sliding motion parallel to the bar and a rotation about the bar. Suppose the frame turned about the bar until the arm A_2 is brought into contact with it. There are now five points of contact so long as the frame is constrained to touch the bars; and it has only one degree of freedom, viz., the sliding motion parallel to the bar. It is kept in contact with these bars by the tension of a spring holding the piece R continually in contact with the third bar. The spring may be regarded as an internal force in the frame constantly exerted to lengthen the dimension c d. If the frame be in its highest position, the tension of the spring may be so adjusted that the frame floats slowly down to the bottom; the

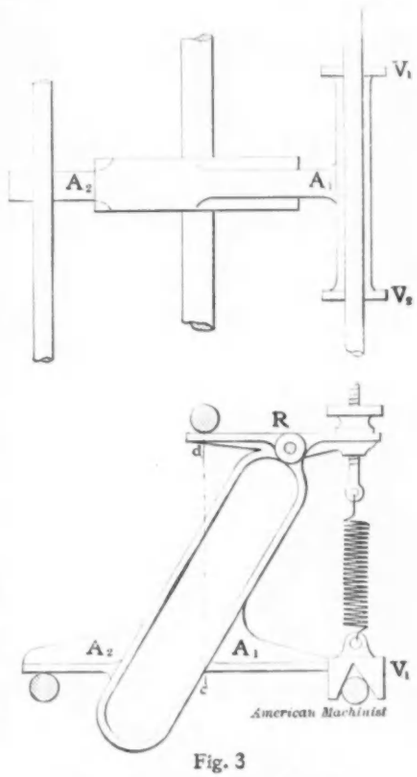

Fig. 3

REGISTERING PULLEY GUIDES.

* A paper read before the British Institution of Civil Engineers.

spring yielding to all the smaller irregularities of parallelism in the three bars, but constraining contact at the six points during the whole motion.

In this form of measuring apparatus the guide-pulleys are kept in contact with the loops by their weight only. It is desirable to keep their mass as small as possible, so that they may follow sudden alteration in the position of the loops without straining the band; at the same time the force constraining them to follow the loops should not be reduced, *i. e.*, although it is desirable to reduce the mass, it is not desirable to reduce the constraining force. These conditions may be fulfilled by making the pulleys light and constraining them to follow the loops by means of a spring. The spring should be arranged so as to cause a constant constraining force. Taking advantage of the fact that the upward movement of one frame is always equal to the downward movement of the other frame, the spring is arranged to act in the way illustrated in Fig. 4. A constraining spring is fixed to the frame at A_2 by an adjusting screw K. A cord is fastened to the other end of the spring and led round small guide pulleys, and fastened to the frame F_1 at H. Two of the guide pulleys are mounted on the end plates of the slide bars, and the third is mounted on the frame F_2. Suppose the apparatus to be running in the position shown in full lines. The tension on the spring constrains the pulleys to sit in their respective loops. Suppose in consequence of a change of torque on the dynamometer shaft, the upper loop shortens to the position L_1; the lower loop will lengthen by an equal amount, and move to the position L_2. The distance between the points H, A, in the new positions of the frames F_1 and F_2 measured along the cord remains the same. Consequently, in the new positions of the frames the tension on the spring, and therefore on the cord, remain constant. It follows that through the whole range of motion of these pulleys the constraining force is constant, and may be adjusted to any amount by adjusting the tension on the spring.

The measuring apparatus is now independent of gravity, and can be placed horizontally or vertically, or at an angle, the constraining force of the spring keeping the endless band taut. The scale is shown fixed to the frame F_2 and the index to the frame F_1.

Self-Contained Dynamometer.—A dynamometer constructed so as to be self-contained is shown in Fig. 5. It is interposed between a countershaft and a dynamo. The dynamometer pulley is mounted on ball bearings. The steel band is brought away horizontally, and the guide-pulleys in the loops frames and controlling spring are arranged in the same way as shown in Fig. 4. Stops are arranged on the dynamometer shaft, and on the pulley, to limit the relative angular displacement of the spring to about three-quarters of a turn. The diameters of the sprocket wheels Q_1 Q_2 are such as to give to the loops a total range of relative linear displacement of about 10 inches. The springs shown in Figs. 1 and 5 connecting the dynamometer pulley to the shaft are arranged with their axes coincident in each case with the axis of the shaft, so that the deformation produced by the applied torque is in each case a twist. This arrangement has the advantage that it practically eliminates the effect of the centrifugal force acting upon the spring. The spring measuring the torque may be arranged to act in tension if found more convenient. The relative angular displacement of the pulley and the shaft would, in this case, be limited to about 30 degrees, but is only necessary to properly proportion the diam-

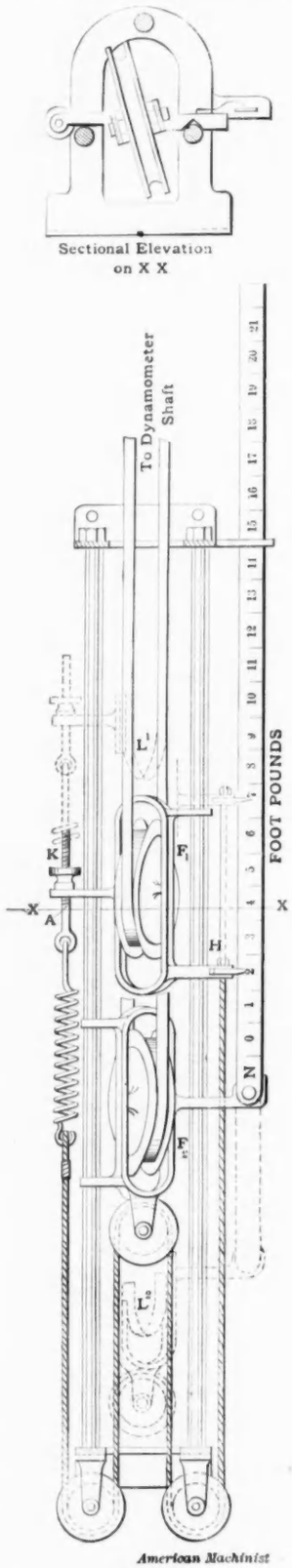

Fig. 4

SPRING LOADED REGISTER.

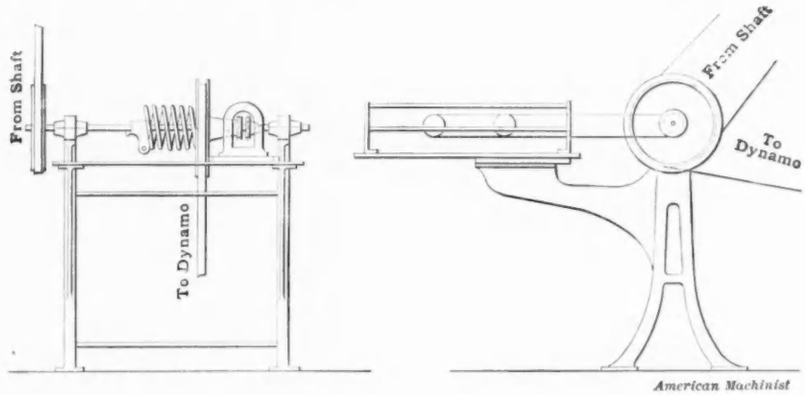

Fig. 5

SELF-CONTAINED DYNAMOMETER.

Load.	Torque.	Scale Reading
Lbs.	Foot-Lbs.	Centimeters.
0	0	Spring against stop.
3.81	1.9	0.77
7.81	3.9	1.83
11.81	5.9	2.94
15.81	7.9	4.08
19.81	9.9	5.20
23.81	11.9	6.32
27.81	13.9	7.43
23.81	11.9	6.36
19.81	9.9	5.23
15.81	7.9	4.11
11.81	5.9	3.00
7.81	3.9	1.87
3.81	1.9	0.77
0	0	Spring against stop.

TABLE I.

eters of the sprocket wheels Q_1 Q_2 to obtain as great a range of motion of the loops as desired.

Calibration.—The scale of the dynamometer may be calibrated by fixing the shaft and applying a known torque to the pulley. The dynamometer shown in Fig. 5 was calibrated in the following manner. The shaft was fixed, and a band of webbing was placed round the pulley, one end being fastened to the pulley, the other end hanging free. The free end was loaded gradually with known weights, and a reading was taken on the dynamometer scale for every change in the loading. Thus the torque was known for a series of points on the scale. The values of the torque and corresponding scale readings are given in Table I. When the maximum load was reached, it was decreased gradually, the corresponding scale readings being taken at every change. The radius of the applied load was 0.5 foot. The readings are given for changes in the load of 4 pounds up and down. From these figures the calibration curve, Fig. 6, has been plotted, from which it appears that a change in torque of 8 foot-pounds produces a change in the scale reading of 4.4 divisions. Therefore our scale divisions correspond to a change of 1.8 foot-pounds in the torque acting on the dynamometer shaft. The scale used was an ordinary centimeter scale divided into millimeters. Knowing the constant, it is easy to construct a scale such that one division corresponds to a change of 1 foot-pound in the torque.

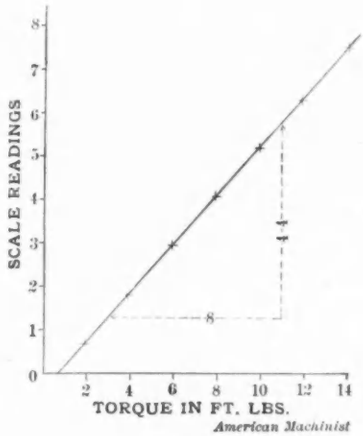

Fig. 6

CALIBRATION CURVE.

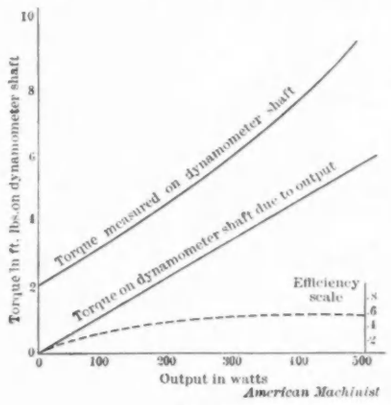
Torque in ft. lbs. on dynamometer shaft
Torque measured on dynamometer shaft
Torque on dynamometer shaft due to output
Efficiency scale
Output in watts
American Machinist

Fig. 7

The advantages of the new dynamometer are—(1) the scale readings are strictly proportional to the torque; (2) the scale may be made very open; (3) the scale may be placed in any position convenient for observing it, being independent of the position of the dynamometer pulley; (4) the scale and index are at rest except during the time a change of torque is taking place; (5) the instrument may be aranged to measure very small changes in the torque without measuring the whole torque.

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The Theory, Organization and Conduct of Professional Schools.

The brief report of the Boston meeting of the Society for the Promotion of Engineering Education, published in our issue of September 8, made mention of an address by Dr. Thurston on the above subject. Our limited space will not permit the publication of the paper even in abstract, but some of its sentiments are so striking, so encouraging, and, we are bound to add, so closely in accord with views which we have repeatedly expressed in these columns, that we cannot refrain from making a few extracts.

The address was opened with words of warm approval of and quoted extracts from what the author considered "the greatest work on technical education ever written—the "Systematic Technical Education" of John Scott Russell. These quotations recited Mr. Russell's enthusiastic indorsement of the German system of technical education as follows:

"Twenty years ago professional duty took me to Germany for the first time. I cannot forget my impression at the sight of whole nations growing up in the full enjoyment of systematic, organized, I might almost say, perfect, education. I had already become acquainted with some theories and forms of education. I had read Plato's description of the perfect training for a nation. I was familiar with elementary school teaching, and enjoyed the privileges of university education and the still higher education of the workshop. I was familiar with the systems of Bell and Lancaster, having had personal acquaintance with its authors, and had myself taken an active part in schools of art and mechanics' institutions; but I confess to have been profoundly astonished—I may say humiliated—at the sight of nations whose rulers had chosen to undertake the systematic education of their people, and of peoples who had chosen to bear the burdens and to make the sacrifices necessary to obtain it. I do not know to what men or class of men in Germany the forethought, organization and patriotism are to be attributed which made them lay aside personal ambition, political animosity, religious sectarianism, and state parsimony, in order to unite all the classes of people in a unanimous effort to raise every rank in society to a higher condition of personal excellence and usefulness, and, by diffusing equality of education, to extinguish the most grievous of class distinctions."

In discussing the general character of the work of an engineering school as regards the two tendencies toward abstract teaching of broad principles on the one hand and concrete teaching of applications on the other, our editorial of December 9, 1897, was quoted from as a representative argument for the latter course.

Referring to the character of the work done by technical students and the disciplinary value of technical studies the following quotations were made: "A distinguished teacher of engineering has said. 'It is unquestionably a fact that the engineering students of our colleges do more and harder work for a degree of equal grade than do the students of other departments. * * * There can be no denial of the fact that the most earnest students are those who seek knowledge as a direct means of success in life rather than for the mere pleasure of its possession.'

"Quite as good exercise may be found in getting some whither as in walking around the square. * * * Experience shows that the graduates of the more scientific and less monastic and literary courses are, in fact, in no degree inferior, and suffer in no way in the comparison beside the product of the school organized on the plan of the mediæval schoolmen. Every exercise in applied mathematics, for example, gives at once the desired gymnastic training and a new power of accomplishment of useful tasks."

It is, however, Dr. Thurston's views regarding the tendency toward extreme severity of entrance requirements which interest us most, and from which we derive the greatest satisfaction. We quote:

"In the opinion of many of the ablest and most authoritative members of the profession the process of raising entrance requirements has already gone too far, and the result of carrying the process further, for purely sentimental reasons which do not appeal to the people who desire to send their sons to such schools, will be to seriously cripple institutions of this kind in the work of aiding the industrial classes and of complying with the spirit as well as the letter of the law making the 'leading objects' of these schools and of the colleges to which they are attached that of providing technical instruction for those who cannot, because of lack of time, of money, or of talent for literary

work, take the older college courses, and with whom the alternative lies between going into technical schools and going directly into business when leaving the high schools or earlier.

"The fact is, that, with every technical school and especially with every professional school in the department of engineering, the entrance requirements should be made just as few, just as fit and just as precise in adaptation to the courses to be taken up as is by any means possible. The nature of the professional course to be offered, and the sequence of primary studies with its special courses, determine the proper requirements for entrance. To increase entrance requirements by introducing those which do not furnish suitable introduction to work to be taken up is to deprive deserving men, usually the most deserving classes of young men, of the right of gaining a scientific knowledge of the fundamental principles of their chosen profession, or art, or vocation. To raise requirements for sentimental reasons, simply to make entrance into such courses as difficult as into others, is, in the opinion of every person familiar with the equities and the facts of the case, a crime against the people, and especially against the 'industrial classes,' the special care of whom is a primary duty. 'Procrustianizing' is bad in all departments; but procrustianizing in any university seeking to adapt itself to the needs of a people, including the 'industrial classes' as well as the cultured, is an educational blunder, a political mistake and a crime against those classes of society which it is the great purpose of such institutions to give most effective aid.

"In seeking to aid the people in this field, as in any other, it is essential that those proposing to conduct the business offer the people what they desire and need, not, as so often is the case among the older colleges, what the vendor prefers to deal in.

"So long as the colleges offered only classical and academic courses, however well taught, they met the requirements of but comparatively few citizens. When they commenced the construction of the schools and courses of applied sciences, and gave opportunity for the acquirement of technical learning, they began to meet the needs of the great mass of the people and response was prompt. Colleges had lost ground, relatively, for years previously; they have, in these later years, regained all they had lost, and have taken up a rapid and rapidly accelerating progress.

"Cornell University and Sibley College, and nearly all the State universities, have owed a phenomenal growth to the extension of their fields of work into those which are of immediate interest to the average citizen, who, however much he may desire to give his son a liberal education, is through force of circumstances unable to provide both education and professional schooling."

The concluding portion of the address was devoted to the development of the thesis that every State owes it to its people to see that a "complete and perfect," a Miltonian, education, "extending from the gutter to the university," as Huxley put it, is provided, not only for the wealthy seekers of classical and liberal culture, to the ministers, lawyers and doctors of the community, but to "all sorts and conditions of men" seeking to "fit themselves for the sequel of their lives," and including all the usual literary, scholarly and gymnastic curricula, and also all technical branches in manual training schools, trade schools and engineering and architectural schools and colleges, securing such a systematic and general and generous provision for the needs of the people as John Scott Russell would have approved, and, through a wise public provision and supervision, availing itself of the generosity of large hearted and whole souled and patriotic citizens, as well as of the resources of the State itself toward "the education of the people for the life and work of the people."

To all of which we say Amen!

▲ ▲ ▲

Letters from Practical Men.

A New English Lathe—A Sensitive Driller.

Editor American Machinist:

We have read with interest the editorial remarks appended to the article by Mr. Vose appearing in your issue of August 4. As, however, the objections raised are to our mind based upon a misconception of the details of construction (external views of the tools referred to only being shown), we shall be glad to be allowed an opportunity of correcting same.

Referring to the carriage feed of the lathe, this is not by a solid nut, as suggested. A worm-wheel connected by gearing to the large hand-wheel gears with the feed screw, when same is held still by means of the clamp, the worm wheel acts as a nut; but when the hand-wheel is rotated in either direction the worm-wheel runs on the screw as a pinion on a rack. This gives an altogether different action to that described by you, and is in fact precisely as easy to handle as carriages fitted in the ordinary way, with the further advantage that on reaching a dead stop, or any obstruction, the hand-wheel will slip round in the clamp and the carriage cease moving. We cannot at all understand the difficulties supposed to be met with in working the turret shown in the illustration. Both turrets and the compound rest are interchangeable on the carriage, and the same traversing movement across the bed is available for all three. The hand-wheel of the traversing screw being indexed and provided with a pointer, the lathesman knows the depth of his cut before bringing the tool up to the work, and the turret head is handled in precisely the same manner as an ordinary compound rest, no crossing of hands being necessary.

As regards the term "sensitive" applied to a drill press, we have always been under the impression that the term is only rightly used in cases where the whole of the weight of the spindle, hand-wheel, chuck and drill, and all backlash, is taken up in such a way that the actual thrust of the drill is the only thing felt by the hand of the operator. Acting on this assumption we maintain that the drill press made by us more truly answers to the name "sensitive" than those made on the Slate system. The conical spring inclosed in the cap at the top of the spindle is proportioned of such a strength that it just exceeds the downward tendency of the spindle, drill chuck and drill and takes up all backlash, and as the spring revolves with the spindle there is no loss from friction. If there is any backlash in the teeth of the rack of a drill made on Slate system, it is taken up by the thrust of the drill, so long as there is metal to work at; but the moment the point of the drill goes through the downward tendency of the chuck, etc., is free to act on the backlash, and the drill (if a fine one) is instantly broken. If two drill presses be badly made, with plenty of play and backlash, one on the Slate system and one on our own, the former will break drills which the latter will not. The fact that the only pressure on the drill is that of the operator's hand can be demonstrated by the fact that if the hand-wheel of our drill be screwed down to the bottom of its feed while the drill is standing it will run up to the top immediately the drill is started, and its tendency is to run up during the whole time the drill is working. The small hand-wheel shown can be moved and secured in any desired position on the screw, and is used as a depth gage.

HUMPAGE, JACQUES & PEDERSEN.

Bristol, England.

[We are glad to receive the above statement from the makers of the tools referred to, and we hope it will be remembered that in what we have said or may have to say regarding them we speak only from the standpoint of American tool users. That is to say, we aim to present only what an American workman would be apt to think about the tools. And what an American workman would think of them, while it would be very important if the tools were to be used here, does not necessarily affect their value for use in Britain. We consider that the worm-wheel for the lathe feed motion is mechanically equivalent to the solid nut when used in the manner

described, and produces all the effects upon the carriage motion which we ascribed to the supposititious nut revolved by the hand wheel for a hand movement of the carriage and held still for an automatic feed. Such an arrangement, while it would not be objectionable to most British workmen, would be objected to here, simply because here we use the carriage movement upon the bed for practically all movements of the tool in that direction, and it is important that a given movement of the carriage hand-wheel should always mean the same movement of the carriage upon the bed, no matter in which direction the lead-screw may be turning or whether it is turning at all or not.

As to the use of the turret rest in place of the compound rest, our remarks concerning that point have evidently been misunderstood. We referred only to the fact that when the turret rest is on the carriage there is no compound slide and no means of moving the tools *along the bed*, except by the carriage movement, which for the reasons given above does not seem well adapted for such movement when regarded from our standpoint.

The explanation given of the construction and action of the drill press certainly presents that tool in a more favorable light as regards its sensitiveness, and there is no doubt but that it is an excellent machine. But we do not understand the term "sensitive" as Messrs. Humpage, Jacques & Pedersen do. If the term meant what they interpret it to mean then a driller having no backlash or lost motion would be "sensitive," no matter how heavy or clumsy its parts might be. And if sensitive when new, would lose the quality of sensitiveness by wear and regain it by readjustment or repairs. We believe that the quality of sensitiveness results from design and that a driller that is sensitive when new remains sensitive. We understand the quality of sensitiveness to be imparted by making the parts composing the feed motion, and in fact all parts the motion of which must alter or be reversed when the vertical movement of the spindle is altered or reversed, as light as possible, and so arranged that any extra resistance encountered by the drill is instantly felt by the hand of the operator. Any screw or worm movement, and in fact any movement in which upward pressure upon the spindle would not readily move the piece to which the hand is applied in working the machine, would seem to be illy adapted to the purpose. This difference of opinion regarding the meaning of the term sensitive does not affect the value of the driller in question, however, and in all this we have no intention of an attempt to discredit these very original and creditable tools, but only to point out some features of variation from our practice which are interesting mechanically.—Ed.]

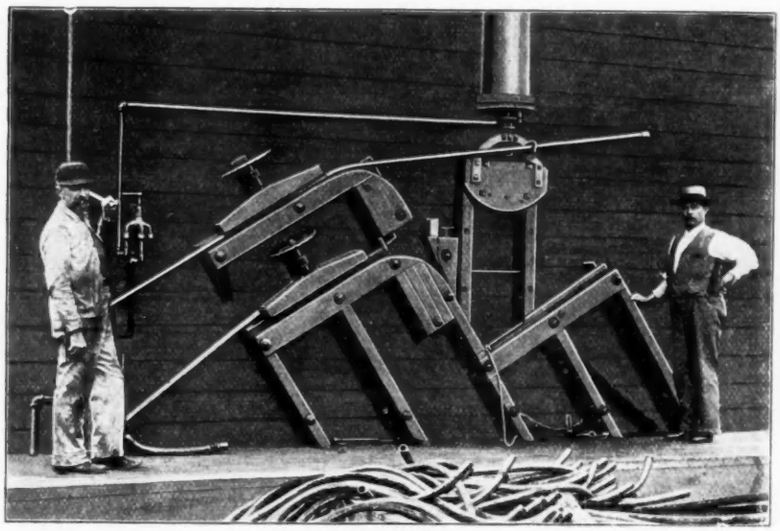

FIG. 1.—MAKING THE FIRST BEND.

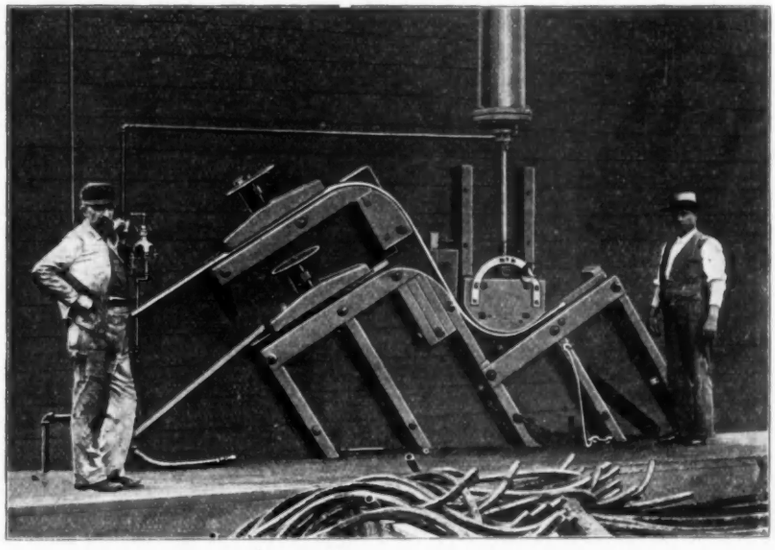

FIG. 2.—MAKING THE SECOND BEND.

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Air Brake Pipe Bending Machine.

Editor American Machinist:

The machine illustrated herewith is used by the D. & H. C. Company at their Oneonta shops for bending the service pipes used in their air brake equipment.

The machine will be seen to comprise two clamps for the pipe, the one used being determined by the work being done, some of the cars requiring the bends to be closer together than others. From each clamp a curved and grooved former leads, and a second former is attached to the piston rod of an air cylinder clearly shown. To the second former a hook is attached for making the first bend in the pipe, as seen in Fig. 1. This bend is in fact started, in case the upper clamp is used, by a hooked rod seen leaning against the frame work. After the first bend is completed the free end of the pipe is sprung under the movable former and the second bend is then made as shown in Fig. 2.

After the bending is done the exhaust from the cylinder is turned through the pipe to blow out the scale, which is loosened by the bending. The pipe is bent cold and without filling with sand, but nevertheless there is no buckling or wrinkling of the pipe, the work being in fact as fine a job as could be asked for.

The machine is all of wood, excepting the cylinder, which is of 10 inches bore. The formers are of hardwood. The bends are each of 90 degrees of arc and

of about 15 inches radius. The air pressure used is 70 pounds.

WM. NEWTON.

Oneonta, N. Y.

▲ ▲ ▲

German Calender Roll Turning.

Editor American Machinist:

In the manufacture (if the word manufacture, indicating a hand operation, be correct in a case where the hands have so little to do) of chilled cast iron rolls, usage in Germany differs radically from that in America.

It was probably the late J. Morton Poole, more than any other one man, who called the attention of the mechanics of the world to the fact that there never was a lathe built that could turn a perfect cylinder, particularly if the work was supported on centers; and his grinding machine, in which the rolls rotate on their own journals, and the removal of material is done by swinging instead of by fixed abrading apparatus, proved this for all time. It is then the custom of American chilled roll-makers, Poole among the number, to cut off the deadhead, center and chuck the work, turn the journals and then remount the roll in a lathe that has neither chuck nor centers, but a simple driver at one end, and bearings in which the work turns on its own previously turned journals. The cuts are made by a hand tool, say a steel bar 6 inches long and 1½ inch square (often with a half inch round groove down the middle of each side), clamped fast and taking off needle-like or wire-like shavings of its own full length. From two to four such tools attacking the work at once (according to the length of the roll) make "short work of a long job," and prepare the cylindrical surface for that triumph of mechanical ingenuity and simplicity, the calipering emery wheel machine.

In the best shops in Germany circumstances have compelled the adoption of another mode of procedure. German iron and American iron are two different sorts of materials, and German casting and American casting are even more widely apart. This being the case, we must expect German castings to differ from what we are in the habit of dealing with. They do. The festive blow-hole, particularly in "coquille" casting, as chilled work is here called, is much more prevalent than with us, and has a habit of residing about two millimeters below the surface, so that the most immaculate and innocent looking roll that one would trust with any amount of preliminary work on journals, etc., until one got to know better, shows bad after one has got both the journals and ends turned, and has run along about five-sixths of the length, turning off the face.

This being the case, the German roll-maker paraphrases the biblical injunction, "Put not your faith in princes," by the substitution of the word "castings" for "princes," and goes at the thing "the other way to." He chucks the piece, deadhead and all, in a lathe that has a face plate with four chuck jaws at each end; takes his rough cut all along it with two "flat-on" tools, consisting of a tool-steel plate about 6 inches wide and 1 inch thick, well clamped, to see if he has a real casting or a collection of assorted blow-holes. If he finds that the working surface is all right, then he attacks the deadhead and the journals, and having got the latter all right, puts the roll in an imitation Poole grinder for a rough scratch all over, and then with another one for the final grinding; in both these machines, of course, the roll rotating on its own gudgeons.

I may say incidentally that about the only fault of the Poole roll lathes and roll grinders is the necessity of having so many sets of bearings—say every 10 mm. between journal diameters of 100 and 400 mm., particularly in Germany, where there appears to be no standard diameter for journals, or else too many—Schulz demanding 150, Müller 155, Lehmann 160, and so on, for the same roll diameter.

I have never seen a German roll lathe yet that did not chatter, and I have seen a good many. For this purpose a lathe is no lathe unless it is stiff enough to make it possible to break the driver or twist off the roll neck, instead of springing the work on the lathe.

ROBERT GRIMSHAW.

Dresden.

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The Noise of the Air Turbine.

Editor American Machinist:

If Mr. Rix was running the fan illustrated in your issue of the 8th inst., at 3,000 revolutions, and it has sixty-eight buckets, as shown by the engraving, he secured about 3,400 vibrations per second, a tone corresponding nearly to A^{iv} on the musical scale. By doubling the number of buckets and running the fan somewhat faster, say, 3,750 revolutions, he would get a tone about C^{vi} of the scale, or slightly above, which, being an octave above the limits of the ordinary piano scale, might be sufficiently high in pitch not to be tiresome to the average ear.

This may, however, place the buckets too close together to secure good results, and it may, moreover, be one of the "three or four" ways he has already tried.

NOVICE.

[Another plan for accomplishing the same purpose, which we have already suggested to Mr. Rix, is to increase the number of jets, keeping the buckets as they are, but arranging the jets to act differentially.—ED.]

For Oiling Crossheads and Guides.

Editor American Machinist:

A neat automatic oiling device for the ordinary four-bar guides and crosshead of steam engines is made by drilling a hole through from side to side of the crosshead jaws through the middle of the wrist pin, tapping one side for an oil cup and the other for a plug. Then drill a hole in the top face of each jaw and one in the top of the wrist pin to intersect the long hole. If the pin is larger than the thickness of the jaws, plane a groove across the top of the hole to make the top of the three holes on the same level. The overflow will oil the top guides and pin. Another hole in each jaw clear through will conduct oil to the bottom guides. A self-feeding oil cup or a wiping device can be used according to choice, or soft grease may be used instead of oil by having the holes drilled, the jaws intersecting the long hole and by having a spring grease cup.

C. W. CRAWFORD.

Brazil, Ind.

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Thawing Dynamite.

All nitro-glycerine compounds freeze and become hard at about 42 degrees Fahrenheit. In this condition they will not readily explode. When large quantities of powder are to be used, a separate building for thawing powder should be fitted with a small steam radiator. Use only exhaust steam for heating the same, if possible, keeping the temperature of the room at about 80 degrees Fahrenheit. In the part of the room at the greatest distance from the radiator, place the powder on racks to thaw. When but small quantities are required to be thawed, a thawing kettle may be used, being two water-tight kettles, one smaller than the other (one placed inside the other), the cartridges to be placed in the smaller kettle, and space between the two kettles filled with hot water of from 120 to 130 degrees Fahrenheit, the kettle being fitted with a cover to retain the heat. Under no circumstances, however, should the kettle be placed over the fire to heat. When more hot water is required empty out the cold water and fill again with hot water. Under no circumstances should an attempt be made to thaw the powder by placing it in hot water or exposing it to the direct action of steam.—New York State Mining Law.

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An English statistician has calculated that it would require a 10,000 horse-power engine about 70,000,000,000 years to lift the earth 1 foot in hight, yet there are men who imagine they jar it a little out of plumb every time they get out of bed in the morning.—Denver Evening Post.

An English Engineer on the Japanese.

Much has been published in praise of the Japanese and of what they have accomplished, and this may have led some to expect to find them in all respects essentially like ourselves. This is unreasonable, of course. The Japanese have not made themselves Europeans nor Americans within the fifty years they have been progressing, but the important fact is that they have very rapidly progressed and seem likely to do so hereafter.

A British engineer, Joseph Wilson, who left his home to go to Tokio as mechanical instructor and to supervise the erection of machinery, sends to the Newcastle "Daily Chronicle" an account of his impressions of Japan and of the people there. He says:

"Will you kindly allow me a little space in your columns in order to describe the various experiences and sensations I have encountered in this most wonderful country, Japan? I left England with the best opinion possible of this country and its people. Since arriving, however, my eyes have been opened very wide indeed to the utter lack of courtesy, or consideration of any sort, which these people may be supposed to extend to anyone visiting them for a fixed period, and also for their common benefit. From the highest to the lowest there seems to me to be the same supreme element of clannish indifference, rudeness and sometimes even contempt. Their boast is that they have accomplished in twenty years what Europe took 500 to accomplish. Their much vaunted civilization is merely what one sees at the treaty ports. Here in Tokio life is just the same as it was centuries ago. The only original characteristic is their curios. One-half the population seems to make them, and the other half sells them. Then, again, their egotism is heartrending. This is one of the results of the China-Japan war. Even yet one finds picture books describing how mere handfuls of Japs put countless numbers of John Chinaman's legions to utter rout. The morality of the country is practically indescribable, and best not touched upon. The Tokio newspapers are a continual source of amusement to we foreigners. By and by I hope to send you some extracts. Business acumen is an unknown quantity among the majority of Japanese merchants. Discipline is null and void, both in the army and navy, and also their mercantile marine. As a people they are neither clean nor yet industrious. They are wholly overrated in every particular. For sobriety, honesty, steadfastness of purpose, industry and civility John Chinaman beats them out and out. They are a nation who will eventually cause their own undoing. This prediction may be verified sooner or later, but sooner, I think, it will be."

Technical Publications.

PROCEEDINGS OF THE SOCIETY FOR PROMOTION OF ENGINEERING EDUCATION. Volume V. Published by the Society. 329 6x9 inch pages.

It is probable that the Society for Promotion of Engineering Education is the most potent influence now at work in the advancement of engineering education, and it is a most gratifying indication of the devotion of teachers of engineering and allied subjects to find them thus organizing a society of this kind, which, according to this volume, has 226 members distributed among thirty-eight States of the Union and five foreign countries. The only criticism that can be made on the composition of the society is the inevitable one that it is one sided, in being almost exclusively composed of teachers. We are persuaded that if engineers in commercial life could be induced to join this association and take an active part in its work, they could do more toward impressing their educational ideas upon our technical schools than in any other way, but in this busy land it is, we presume, too much to expect that such a course will be followed.

The volume contains a table of contents of all previous volumes from which an excellent idea of the work of the association can be formed, and no one can study the lists of papers without an added feeling of the importance of the work done.

THE MANUFACTURERS' EXPORT CODE By Chas. L. Seeger. 600 9½ x 12 inch pages. U. S. Industrial Publishing Company. Price, $10.

It is by evidence such as that furnished by this book that we are led to realize the important position already reached by American manufactured goods in the markets of the world, for it is distinctly a manufacturers' rather than a merchants' or a stock operators' code.

It contains several new features, chief among which is the fact that all phrases are given in both the English and Spanish languages, and, inasmuch as the same code word belongs to both English and Spanish phrases of the same meaning it follows that the code may be used between English and Spanish speaking persons, even though neither understands the language of the other. It may, in fact, be used freely between people who understand either of the two languages.

The alphabetical arrangement of the phrases is abandoned of necessity, owing to the use of two languages, but we think without loss. The alphabetical arrangement necessitates the use of the first word of the phrase as the key word, even though it may be a, the, at, on, or other equally unimportant word, which gives little assistance to the user, as the word which comes to his mind as the key is necessarily the one of most importance regardless of its position in the phrase. The key to the phrase wanted in this book is in the classification and in a very full index.

The book is divided into seven parts, the first five of which relate to such subjects as correspondence, time, weights and measures, money, credits, exchange, litigation, orders, shipments, insurance, commission, markets, contracts, etc., while Parts VI. and VII., which comprise about two-thirds of the volume, relate directly to manufactured articles, Part VI. being devoted to staples, while Part VII. is given to specialties made by different manufactureres, each of whom occupies a section under his own name. In the field of work with which we are best acquainted the names which thus appear are worthy representatives of the country, most of them having already made their mark on foreign trade.

One thing which we see to criticise is the small number of code words without definitions. These are always needed in larger number than code makers think and should be supplied in abundance. Another is the title, which, as given on the title page and on back of cover, is "The Manufacturers' Export Code," while as given on the front page of cover, where it will be seen more than in both the other cases, it is "Seeger's Telegraphic Code." Such a publication should have one and only one distinctive title for obvious reasons.

PRACTICE AND THEORY OF THE INJECTOR. By S. L. Kneass. 161 6x9 inch pages, with 48 illustrations. Second edition. Wiley & Sons. Price, $1.50.

This book is considerably enlarged from the first edition, seventy-one pages having been added. The additions are of a practical character and relate largely to the testing and repairing of injectors. Illustrations of an injector testing outfit are given and the author considers that any railroad or other large buyer and user of injectors should have such an outfit. The book will be found interesting to anyone desiring to understand the action of the instruments, and useful to anyone interested with their supervision and repair.

EASY LESSONS IN MECHANICAL DRAWING AND MACHINE DESIGN. Vol. 1. By J. G. A. Meyer. 405 10x13 inch pages, with over 500 illustrations. The Arnold Publishing Company. Price, $7.50.

This volume comprises the monthly parts of Mr. Meyer's work which have been noticed from time to time in our columns. In the bound volume the scheme of treatment and the continuity of the subjects is of course more apparent than in the separate parts, and the work as a whole is one which any ambitious mechanic may well aspire and be proud to own.

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The Strength of Pulleys.

There are few simple structures the study of the strength of which offers greater difficulties than the simple belt pulley. Many years ago "Chordal" in these columns explained in his unique way the opportunities of this problem in the way of mathematical gymnastics. In point of fact, however, all analytical discussions of the strength of pulleys are based on assumptions which cannot possibly be true, while the unknown factor of shrinkage strains would vitiate the results, even were the assumptions correct.

In another column will be found the results of an original experimental investigation of the subject which is, we believe, the first of its kind to find its way into print, and it furnishes the only rational guide in existence for the design of this important machine member. It will be seen that a leading object of Professor Benjamin's work is to determine what portion of the total load is carried by the most severely strained arm—that is, the one which breaks when the pulley is loaded to rupture. The common assumption is that the load is divided equally among the arms—an assumption that cannot in the nature of things be true, but of whose degree of untruth no theoretical investigation can give a clue. The facts are, however, brought out very neatly in this investigation by comparing the calculated strength of one arm with the total load at rupture. It is obvious that if the load were divided equally among the arms of a six-arm pulley, the gross breaking load should be six times the load which one arm can carry, while in fact, in the case of cast iron pulleys, it is but three times, showing that the most severely strained arm carries twice the load which the assumption of equal division of the load would give it. Of course the language used above ignores the shrinkage strains, but the conclusion is none the less sound, as it shows correctly the relation between the load applied and the calculated strength of the arms.

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Help Wanted.

A technical journal such as this if written by one man would be a dull and unprofitable thing.

In order to make the "American Machinist" what it should be we must publish articles from a great many different men with widely varying experience. We want every reader, no matter where he may be located or what may be his line of work, to consider that he has a standing invitation to contribute to our columns. Don't hesitate because you have no experience in writing or for any other reason, but do the best you can with whatever you may have that you think may possibly interest other readers. We will do our part by paying for articles we make use of that describe shop processes or appliances.

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Decision was recently handed down by a judge of the United States Circuit Court denying the motion for a preliminary injunction in the suit brought by Allen G. N. Vermilye against the Erie Railroad Company to restrain the railroad from using a patent interlocking switch.

In his opinion denying the motion the judge said that the patent on the interlocking switch expires on November 1, 1898, or two months after the argument on the motion; that the defendant has in use about 1,100 of these switches on 2,000 miles of its track, and that it is the custom where an injunction is granted in a suit of this kind to allow time for the removal of the devices in suit, and permit them to be removed only in instalments, so as not to interfere with the operation of the railroad. If the custom were followed few of the switches could be removed before the expiration of the patent.

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In these days the machinist is not be blamed for thinking he can do almost anything in his shop, but he sometimes carries it a little too far. A friend of ours lays claim to the production of oil portraits by a new process and sends us a sample of his work, which was made merely as an incident to sharpening his knife on an oil stone. He took a piece of paper, folded it over the blade, drew the blade out and, behold! a striking picture of a man—a Canadian with a fur cap on, but in his shirt sleeves. We cannot, however, admit that machine shops may be expected to drive portrait painters out of business. The portrait before us lacks feeling, there is a certain stiffness about it and the coloring is bad—so bad that the artist would probably be accused of color blindness. We think our friend had better go on building engines and be satisfied with his lot.

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According to American contemporaries, a train hauled over the Pennsylvania Railway between Altoona and Columbia, consisting of 130 cars, was nearly three-quarters of a mile in length, and weighed 5,330 tons. It was made up as follows: Locomotive, 118 tons; other rolling stock, 1,519 tons; freight (coal), 3,693 tons. The tons are of 2,000 pounds, and no doubt the speed was very low. It would be of interest to know how this enormous train was started.—"The Engineer." It probably was started by opening the throttle. We usually start them that way.

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Questions and Answers.

Name and address of writer must accompany every question. Questions must pertain to our specialties and be of general interest. We cannot undertake to answer by mail.

(89) A. E. D., Keokuk, Ia., asks if there would be a market for a reversible non-dead center rotary engine. A.—There would undoubtedly be a large sale for a really good and economical rotary engine. Hundreds of these have been devised, but their history is a uniform one of failure, and we advise you to look very carefully into what has been done and what the causes of failure have been before you spend your time or money on the project. The problem is undoubtedly one of great difficulty, and you should neither belittle these difficulties nor ignore the long history of failure that has preceded you.

(90) W. F. R., Lincoln, England, asks for general information on the process of pickling brass castings, such as oil cups, pump boxes, injectors, etc. A.—Mr. Abram Ammerman, superintendent of the Jackson Architectural Iron Works, of this city, informs us that the mixture used at that establishment is: 2 parts by measure of nitric acid and 3 parts sulphuric acid, with a handful of table salt to each quart and no water. The pickle may be held in any suitable receptacle, say, of glazed earthenware, or a vitrified bath-tub might do, although it is only necessary to provide a vessel large enough for the immersion of the largest piece to be handled. The pieces are simply dipped in and removed at once and rinsed in clear water. This is merely for cleaning and brightening the castings. Various dips are used for giving different colors.

Commercial Review.

NEW YORK, Monday Evening, September 19.

DYNAMOS AND MOTORS.

One of the most interesting developments of the last two years has been the growth of the Walker Company. Built upon the foundation of a concern relatively small, it sprang into the position of an important competitor with the General Electric and the Westinghouse companies, which had hitherto practically monopolized the street railway work of the country and had obtained lions' shares of other electrical orders. Its phenomenal success in securing large contracts at home and abroad could not but be regarded by the older companies with discomposure, and therefore there is little to cause surprise in the announcement that a consolidation of the Walker and Westinghouse companies has been agreed upon. It is rumored that the New York Air Brake Company may be let into the consolidation, and also that a union may be formed with the General Electric. An organic fusion of the Westinghouse and General Electric companies is a subject already threadbare. A working agreement, as regards the use of patents, went into force between them in 1896.

A statement is made that the Walker plant, Cleveland, Ohio, will be doubled in size.

The flourishing condition of the electrical machinery market, from a broad point of view, is attested not only by the prosperity of the Walker Company, above alluded to, but by the prodigious expansion of concerns whose reputation was made long ago. The General Electric Company's sales for 1898, if they continue to the end of this year as they now give promise of doing, will be about one-half again as large as those of 1897. We have been asked not to publish the actual figures mentioned to us, but it is hardly necessary to say that the increase represents an amount of money sufficient to capitalize a fair-sized railroad.

Among medium-sized electrical companies shop activity day and night still seems to be the rule. Some favorable reports of present office work are heard also, but yet several very representative concerns report a comparative dearth of new orders. Such a state of affairs is, indeed, surprising at this time, and there is little reason to fear that it will be long continued or serious.

In the street railway line the General Electric Company has lately sold 300 double motor car equipments to the Metropolitan Street Railway Company, New York; fifty to the Consolidated Traction Company of New Jersey and twenty-five to the Brooklyn Heights road. An English order, which came a few weeks since, was to furnish to a tramway in Bristol 100 car equipments and electrical machinery for the power plant.

Two fair contracts for factory power purposes, which were the object of some competition in this market have been secured by the Bullock interests. One is for a motor equipment for the Bayonne, N. J., plant of the Pacific Coast Borax Company. It comprises about 150 horse-power, mostly in units of 10 and 15 horse-power. The other calls for a 150 kilowatt generator and a 125 horse-power motor for the plant of J. B. King & Co., plaster manufacturers, Roslyn, L. I.

For the village of Watervliet, N. Y., best known perhaps in connection with the United States arsenal there located, has just been purchased an electrical plant, including a 125-lamp arc lighting dynamo and a 33 kilowatt alternator, from the Fort Wayne Electric Corporation; a 250 horse-power Corliss engine, of Knowlson & Kelley make, and three 125 horse-power boilers, the latter procured through the medium of the engine firm.

Word has come by letter from Cuba that a party was about starting thence to purchase a plant for lighting the streets of Santiago, recently rendered famous. It is believed that an arc lamp circuit for this purpose will be installed, and that an incandescent system will also be put in. According to calculation the party intending to negotiate the purchase has arrived here by this time.

CHICAGO MACHINERY MARKET.

The mercantile branches of machinery builders in this city have been gladdened this week by the presence of a number of country buyers, manufacturers of various lines, who were in need of additional tools. They received due attention, for the street has not reached that stage of activity when there is danger of a prospective buyer being slighted. It can be safely chronicled, however, that there is a gradual bettering of trade; moderate, but unmistakable; partial, but wholesome, and filled with the promise of better things in the future. This broadening of the market extends to almost all of the standard users of iron-working machinery. The wood-working tool market is in an earlier stage of convalescence. Reference has several times been made to the improved buying of the large agricultural implement works. It is not a repetition, but a statement of wholly new business, to say that this line has been quite active during the past week. Each of the three large implement plants in Chicago has made large additions to its works this summer and has been equipping its new buildings with new machinery, buying to an extent unknown before. This buying has been going on for two months, and may now be said to be over for the season.

To a proportionate degree, activity is observable among the smaller agricultural implement shops of the West. From this source has come much of the

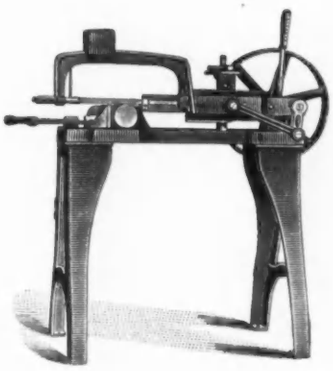
(*Continued on page 34.*)

"The best is as good as any."

The New

Automatic and Gravity Feed

Q & C Shop Saw



Cuts { Tool Steel, Machinery Steel, Iron, Brass and All Other Metals.

Price—'Way Down.

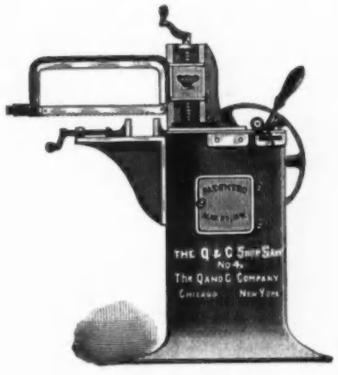
Quality—'Way up.

Shop Saws,

Portable Rail Saws,

Cold Power Saws,

For All Purposes.



Send for Catalogue.

Q & C Company,

Chicago. New York.

LONDON : Chas. Churchill & Co.
PARIS : Hounsfield & Fils.
BERLIN : Schuchardt & Schutte.
MADRID : J. G Neville & Co.

(*Continued from page 33.*)

buying of the past two or three weeks. The immense additions that have been made to the larger plants would seem to indicate that the tendency of production is strongly toward concentration, but the needs of the farming regions have been so great and the variety of implements so wide that large and small shops alike have shared in the conditions, which have made the extensive purchase of new tools imperative.

But there have been other customers in iron-working machinery. Among the buyers have been bicycle and bicycle specialty manufacturers, railroad companies, manufacturers of gas engines and various other lines of manufacture. The jobbing machine shops are not helping the trade to the same degree as the manufacturers.

Electrical work shows some improvement this month, but it is the general comment of the trade that the business in sight is much greater than that that has been recently closed. Selling agencies are now figuring upon quite a number of large specifications. Several new contracts have been made with the packers, who are not departing from their recent policy of putting electrical power into their extensive packing houses. Manufacturers of direct current dynamos for municipal lighting in the smaller towns report a better trade.

The Western iron and steel markets continue to improve. The conditions are much the same as in machinery. Volume is expanding, but prices do not keep pace. Quotations are slowly rising, but mills and furnaces are hampered by an excess of business. The uplift in values refuses to come, or it comes reluctantly. There is, however, some talk of further advances in merchant steel, bars and similar products.

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Quotations.

NEW YORK, Monday, September 19.

Iron—American pig, tidewater delivery:

No. 1 foundry, Northern	$11 25 @ 11 50
No. 2 foundry, Northern	10 75 @ 11 00
No. 2 plain, Northern	10 25 @ 10 50
Gray forge, Northern	9 75 @ 10 00
No. 1 foundry, Southern	10 75 @ 11 25
No. 2 foundry, Southern	10 50 @ 10 75
No. 3 foundry, Southern	10 25 @ 10 50
No. 1 soft, Southern	10 75 @ 11 25
No. 2 soft, Southern	10 75 @ 11 00
Foundry forge, Southern	9 50 @ 10 00

Bar Iron—Base—Mill price, in carloads, on dock: Common, 1.05 @ 1.10c.; refined, 1.15 @ 1.20c. Store prices: Common, 1.30 @ 1.35c.; refined, 1.35 @ 1.50c.

Tool Steel—Base Sizes—Standard quality, 6 @ 7c., with lower prices on some brands; extra grades, 11 @ 12c.; special grades, 16c. and upward.

Machinery Steel—Ordinary brands, from store, in small lots, 1.45 @ 1.50c.

Cold Rolled Steel Shafting—Base sizes, from store, 2.20 @ 2.25c., according to quantity.

Copper—Carload lots, Lake Superior ingot, 12⅜c.; electrolytic, 12⅛ @ 12¼c.; casting copper, 11⅞ @ 12c. for ordinary brands.

Pig Lead—Carload lots, 4c., f. o. b. New York.

Pig Tin—For 5 and 10 ton lots, 16.20 @16.25c., f. o. b.

Spelter—Carload lots, 4.80 @ 4.85c., New York delivery, for ordinary brands.

Antimony—In cask lots: Cookson's, 9⅝ @ 9¾c.; Hallett's, Japanese and French E. B., 9c.; United States, 8.70 @ 8.75c.

Lard Oil—Prime city, ice pressed, 44 @ 45c., in wholesale lots.

WANTED!

Machinery, second-hand, must be in first-class order.

36 in. or 38 in. swing lathe, with compound rest, 15 or 16 ft. centers.
12 ft. boring mill, either with single or double head.

C. C. WORMER MACHINERY CO.,
DETROIT, MICH.

U. BAIRD MACHINERY CO.,

523-525 Water St.; 524-526 First Ave.,
PITTSBURGH, PA.

MACHINERY
—OF—
Duquesne Mfg. Co. Bicycle Factory
FOR SALE.

All Modern Tools, in EXCELLENT CONDITION.

WRITE FOR OUR LIST, JUST COMING OUT.

The CROSS OIL FILTER

actually reduces oil bills 50% or more. Sent on approval. Capacities 3 to 120 gals. per day. Used in 18 countries. Testimonials from the leading firms in every field of industry.

THE BURT MFG. CO.
AKRON, OHIO, U. S. A.
Business Established 8 Years.
Largest Manufacturers of Oil Filters in the World.

14 IN. x 5 FT. Bradford Muller Lathes.
25 of them. Almost New. Low Price.
The Lodge & Shipley M.T. Co.
Cincinnati, O.

MACHINE DESIGN TAUGHT BY MAIL.

Correspondence instruction, of which the Chautauquan system is a well-known example, was first applied by the Colliery Engineer Company, of Scranton, Pa. (proprietors of the International Correspondence Schools), to teaching the theory of the mechanical trades and engineering professions in 1891. Successful from the beginning, the scope of the schools has been extended until there are more than fifty courses and over 50,000 students and graduates.

The complete Mechanical Scholarship is intended especially for Machinists, Pattern-Makers, Boiler-Makers and Apprentices to those trades; for Superintendents, Foremen and others who desire to study the theory of Mechanical Engineering or to review mechanical subjects which they have previously studied, and for young men who wish to educate themselves as Mechanical Engineers. The course includes instruction in Steam and Steam Engines, Strength of Materials, Applied Mechanics, Boilers, Machine Design, Dynamos and Motors. A thorough preparatory course in Mathematics, Physics and Mechanical Drawing enables the student to study intelligently the more advanced subjects.

MECHANICAL DRAWING.

Mechanical Drawing is taught by a new and successful method. We have taught men to make neat, well-lettered drawings who, when they began, did not know one drawing instrument from another. The student is taught the use of the instruments and Geometrical Drawing and is required to make a number of plates and tracings. The student also draws to scale a complete steam engine, plan and elevation, from free-hand sketches on which the dimensions have been marked, as is ordinarily done in the drawing-room, and makes a tracing of the lead-pencil drawing.

SUCCESSFUL METHODS.

Our method enables any man who will study to secure the necessary technical education to advance in his trade or profession. His studies need not take time from his work, but can be carried on at home. Specially prepared Instruction Papers take the place of text-books and are furnished free. The cost of tuition is less than the price of the text-books which would be required to study the same subjects. All work must be written, preparing the student to pass examinations, and furnishing a complete record for review. No time is set in which the course must be finished, and the instruction is continued until the student receives his Diploma.

SUBJECTS TAUGHT.

We also teach Electricity, Architecture, Architectural Drawing and Designing, Steam Engineering—Stationary, Locomotive or Marine; Civil, Railroad, Bridge, Municipal and Hydraulic Engineering; Coal and Metal Mining, Plumbing and Heating, Prospecting and the English branches.

TERMS OF PAYMENT.—In advance or installments of $5 or $2 a month.

If you will mention the subject in which you are interested we will send you Free a circular of information containing a brief history of the schools, with a full description of the courses, the method of teaching, prices of scholarships, sample pages of the Instruction Papers and a reduced specimen of a drawing plate.

Address THE INTERNATIONAL CORRESPONDENCE SCHOOLS,
Box 819, Scranton, Pa.

Business Specials.

Gear wheels, gear cutting. Grant; see page 16.

Forming Lathes. Mer. Mach. Tool Co., Meriden, Conn.

Send for my water tube boiler catalog. E. P. Watson, Elizabeth, N. J.

Selden Packing for stuffing box, with or without rubber core. Randolph Brandt, 38 Cortlandt st., N. Y.

Cutters, reamers and small tools, regular and special; vertical millers, cutter and surface grinders, shears and punches. R. M. Clough, Tolland, Conn.

For Sale or Rent—Foundry and machine shop with additional land, in good condition and well equipped for medium heavy work; capacity of foundry 7 tons per day; located on railroad within eight miles of New York; terms easy. Call or address J. F. Sweasy, 26 Nassau street, New York

Wants.

Situations and Help Advertisements only inserted under this head. Rate 30 cents a line for each insertion. About seven words make a line. The cash and copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded.

Situations Wanted.

Situation as foundry foreman by sober hustler; best reference. Box 240, AMERICAN MACHINIST.

Exp. mech. draftsman, electrical work, hoisting or general mach.; A1 references. Box 248, AM. MACHINIST.

Draftsman wants change; prefers light watch machinery or similar work; good ref. Box 250, AM. MA.

Young man, ten years' experience on machines, tools and model work, wishes sit. Box 251, AM MACH.

Foreman. A1 practical mechanic, desires position; experienced light machinery or tool room; references. Address Box 246 AMERICAN MACHINIST.

Wanted—Position by draftsman; tech. graduate; seven years' experience on electrical steam and mach. design; best of ref. Box 256, AMERICAN MACHINIST.

Foreman molder and pattern-maker wish to change; both middle aged and experienced men; West or South preferred; good ref. Box 253, AM. MACHINIST.

A first-class mach. and draftsman wants position as foreman or assist. supt of machine shop; has held positions as general foreman; best of references furnished. Box 208, AMERICAN MACHINIST.

Experienced mechanical superintendent will be open for an engagement Oct. 1; general and special machinery, interchangeable work, tools, fixtures, etc.; brass and iron. Box 254, AMERICAN MACHINIST.

Superintendent or manager is open for position; practical mechanical engineer with office and business exp.; can handle office or shop or solicit trade; good character; ref. Address Box 234, AM MACHINIST.

Wanted—Position as general manager or super. of engine and general engineering works; accustomed to handling all depts.; thoroughly ex. in the produc. of work and the handling of men. Box 227, AM. MACH.

Brass foundry foreman wishes position; up-to-date in running foundry; mix old and new stock; good handler of help; core making, machine work and all details of work; light and heavy castings. Box 247, AMERICAN MACHINIST.

An experienced and successful draftsman and designer in light and heavy automatic machinery, and in the development of new machinery, wishes to change from present position of long standing. Box 245, AMERICAN MACHINIST.

Mechanical engineer of ability, thoroughly familiar with hydraulic engineering and water wheels, and with experience in steam engines and general machinery, is open for responsible position. Address Technical Graduate, AMERICAN MACHINIST.

Mechanical engineer now located in New York State, accustomed to handling correspondence, desires position in charge of city office, or would accept position as first assistant with good concern; excellent references. Address Box 233, AMERICAN MACHINIST.

Help Wanted.

Wanted—Foreman for high speed engine shop; state experience, age and pay expected. Box 257, AMERICAN MACHINIST.

Wanted—One all-around, up-to-date, wide-awake blacksmith; must know his business. Address Atlanta Machine Works, Atlanta, Ga.

Machinists wanted near Albany; first-class men on boring mills; none but first class workmen need apply. Box 236, AMERICAN MACHINIST.

Wanted—One pattern maker for mach. shop building engines and general work; state age, exp. and wages expected. Address Box 239, AMERICAN MACHINIST.

Wanted—General foreman for country shop building turret machines; also planer, lathe and bench hands; state exp. and wages expected. Box 237, AM. MACH.

Wanted a mach. shop foreman who understands thor. econ'cal produc. of center crank engs. in quan; desirable location; state wages. Box 258, AM. MACH.

Wanted—A machinist, a good scraper hand, in a large New England city; steady job to the right man. Address, giving particulars and stating wages, Box 235, AMERICAN MACHINIST.

Wanted—A foreman for tool-room in large machine works in New York; give experience, age and where last employed, and state wages required. Address Tool Room, AMERICAN MACHINIST.

16 in. x 6 ft. Hendey-Norton Lathe.

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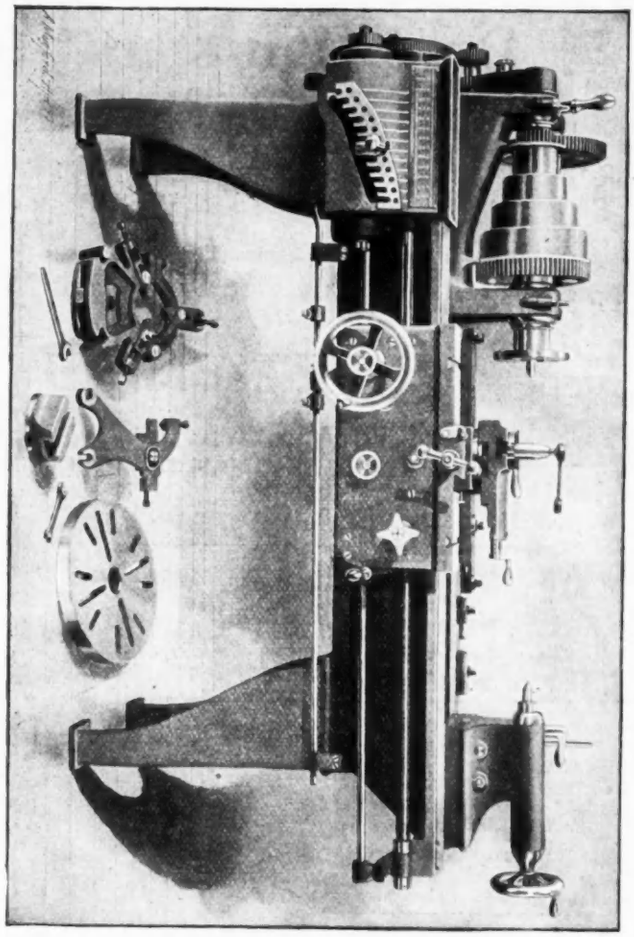
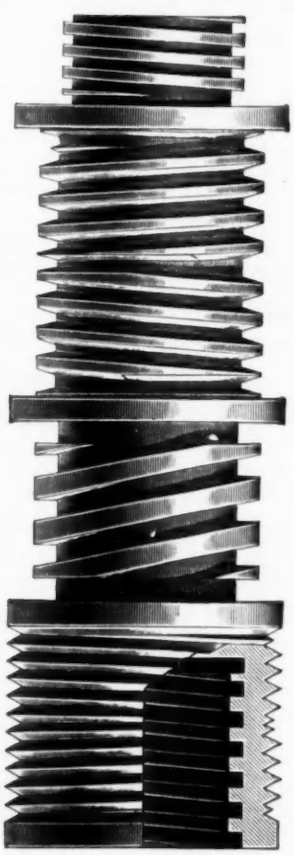


THE HENDEY-NORTON ENGINE LATHE is the most modern type of engine lathe extant. Why? Because it has the best improved attachments known for the rapid and accurate production of high-class lathe work in use on engine lathes at the present time.

One is the Norton arrangement of change gears for screw cutting. All the change gears are mounted in the gear box ready for use. The different pitches are obtained by the simple movement of handle in gear box from one notch to the other, carrying with it an intermediate gear meshing into the cone of change gears. Thus every thread required in ordinary use is obtained on the instant, and this applies equally well to the feeds.

Another is the reversing lever at side of apron. At the moment of changing travel of carriage, as when cutting threads, you have but to move up or down this lever when the *carriage*—not the countershaft, belt, head spindle and work—returns in the opposite direction, and so on till work is finished. This saves wear and tear on working parts.



In this specimen of thread cutting we have a good illustration of the above features; but it is here shown to illustrate in particular what our Automatic Stop will do. It shows how threads can be cut to and from shoulders, both internally and externally, tool stopping to a certainty, and with work in motion. This feature is equally applicable in turning work in duplicate. The Automatic Stop is at once positive and simple.

The Hendey Machine Co.,

Torrington, Conn.

AGENTS FOR THE PACIFIC COAST:

Pacific Tool & Supply Co., San Francisco, Cal.

J. W. Cregar, Philadelphia Bourse Exhibition.

EUROPEAN AGENTS:

Schuchardt & Schutte, Berlin, Vienna, Brussels.

Chas. Churchill & Co., Ltd., London and Birmingham, Eng.

Adolphe Janssens, Paris, France.

Help Wanted—Continued.

Wanted—A good man as assistant layer-out in large boiler shop; give reference and wages wanted. Struthers, Wells & Co., Warren, Pa.

Wanted—First-class tool makers, accus. to light interchangeable work; steady employment at $3 per day if satisfactory. Address, Box 252, AM. MACHINIST.

Wanted immediately — Experienced mechanical draftsmen; permanent positions to comp. men; state age, ex., ref. and salary expected. Box 255 AM. MACH.

Wanted—Good machinists and tool makers in large machine works in New York; give experience and age, where last employed and wages required. Address Machine Shop, AMERICAN MACHINIST.

Wanted—A competent mechanical draftsman on light machinery; should have a good technical education and some experience in shop practice; state salary expected. Address Baltimore, care AM. MACH.

Wanted—A thoroughly competent machinist to give instruction in a tech. school; state age, educa., shop experience, salary required, and send ref. and photo to C. A. Bennett, Bradley Polytech. Inst., Peoria, Ill.

Wanted—Foreman for engine works; state experience, age, reasons for desiring a change, and salary expected; this is a good chance for the right man to become a superintendent. Address 249, AM. MACHINIST.

Wanted—A superintendent for old established machine tool factory in New England; man competent to produce best work at least cost; give references, experience, terms, etc. Box 242, AMERICAN MACHINIST.

Wanted immediately an up-to date, exp. foreman of machine shop; one accustomed to heavy marine engine work; will consider only first-class man, with satisfactory references. Apply by letter to the Harlan & Hollingsworth Company, Wilmington, Del.

Wanted—An experienced mechanic competent to handle an important agency for machine tools in a large city; must have the highest testimonials and exp. as office man; all communications will be treated as strictly confidential. Address Box 241, AM. MACH.

Wanted for works in England first-class draftsman as designer of small tools, jigs, cutters, etc., for use on hand and automatic screw machines, milling machines, etc.; good job for capable man. Reply, giving full particulars of experience, age, salary, etc., to Box 243, AMERICAN MACHINIST.

Wanted—Two or three good machinists, those having had good experience on lathe preferred; also one first class blacksmith for general machine work, both heavy and light, and must have experience with steam hammer. Address, stating age, experience and character, Box 238, AMERICAN MACHINIST.

Wanted—Experienced young man capable of handling 40 to 50 men, to take charge of machine work in engine department; permanent pos.; opportunity for advancement; state, age, exp., refs and sal. wanted; an experienced erecting man for the road also required. Buffalo Forge Co., Buffalo, N. Y.

Wanted for England, a first-class machine tool draftsman as designer; accustomed to high-class milling machines, hand and automatic screw machines, &c.; good berth for a capable man. Reply, giving full particulars of age, experience and salary required, in confidence, to Box 221, AM. MACHINIST.

Wanted—By a company mfg. a general line of engine work ambitious young men who have served their regular apprenticeship and are looking for a permanent position in a shop where faithful service is appreciated; in replying state size and kind of machine and work you are most accustomed to; state wages desired. Engine Company, care of AM. MACHINIST.

Miscellaneous Wants.

Advertisements will be inserted under this head at 30 cents per line, each insertion. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded.

Philadelphia Book Co., Phila., Pa., catalog free.

Caliper catalog free. E. G. Smith, Columbia, Pa.

Dies and press tools. J. L. Lucas, Providence, R. I.

Book, Dies & Die Making, $1. J. L. Lucas, Prov., R. I.

Kit pattern or cabinet makers' tools, $30; cost $70. Box 244, AMERICAN MACHINIST.

The Dutton Wet Twist Drill-Grinder is sold by the Garvin Machine Co., New York City.

Light and fine mach'y to order; models and electrical work specialty. E. O. Chase, Newark, N. J.

Wanted—A good second-hand universal milling machine, back geared; give condition, make, price, description. Address Box 234, AMERICAN MACHINIST.

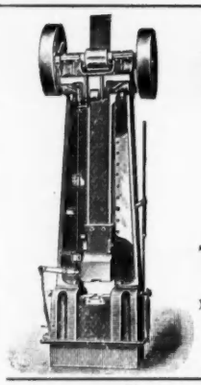
To buy working drawings and patterns, either or both, for an up-to-date lathe in sizes 14 in. by 6 ft. and 18 in. by 8 ft. Ad. Alexander, care AM. MACHINIST.

Gasoline Engines, all sizes, 1 to 60 H. P.; send for circulars, terms and prices; castings fur. to build your own engs. Dirigo Eng. & Mach. Works, Portland, Me.

The advertising department of the American Machinist has on hand 20,000 draftsm'n's thumb tacks; will send a box of ten to any draftsman in America on request; could use a postage stamp on box, but will send the tacks anyway.

Institutions retiring from business having machine tools, brass or wood working machinery, will find it to their interest to correspond with us. We purchase complete plants or handle them on com. C. C. Wormer Mach Co., 55-59 Woodbridge st., W., Detroit, Mich.

For Sale—On account of death, 15 horse-power engine, 20 horse-power boiler, in good condition; 20 feet of 2 inch line shaft, pulleys, hangers; one granite polishing machine; one drill machine for iron, very cheap. A. Durkes, 652 Lewis street, Union Hill, N. J.



Drop Hammers Recently Improved.

Have the metal of the most enduring qualities intelligently distributed throughout. PAPER PULLEYS that give no trouble. Hammers and Die Blocks of steel. JOINTS and BOLTS CUSHIONED with rawhide or leather. BEDS of each size, 250 to 2,400 pound hammers, made 10 and 15 times the weight of the hammer.

DIE SINKERS, four sizes; TRIMMING PRESSES, two sizes.

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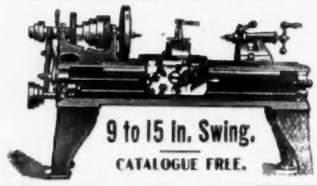

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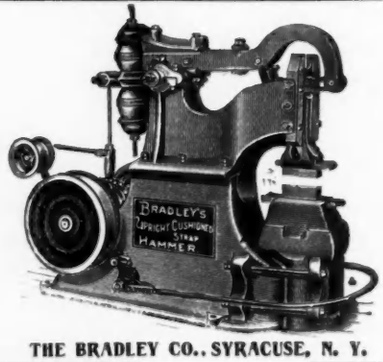

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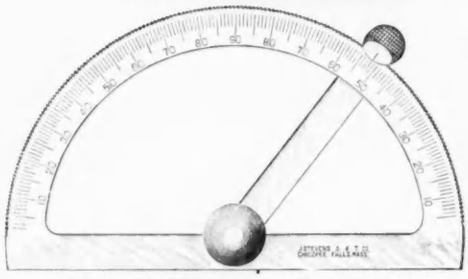

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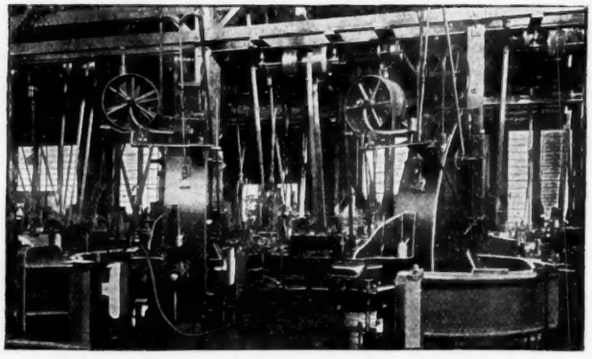

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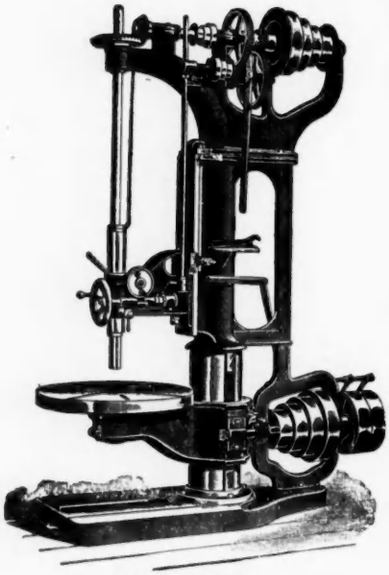

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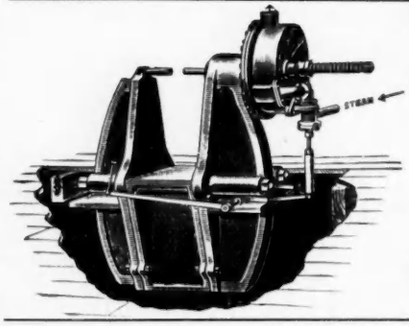

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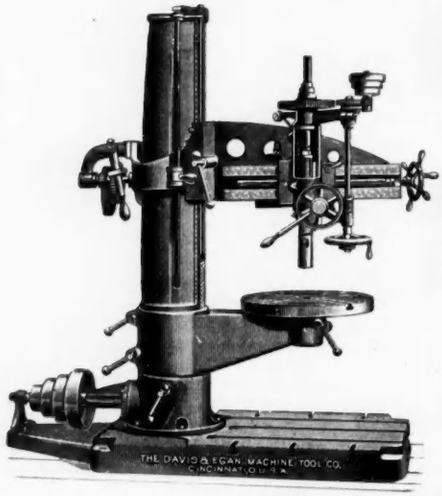

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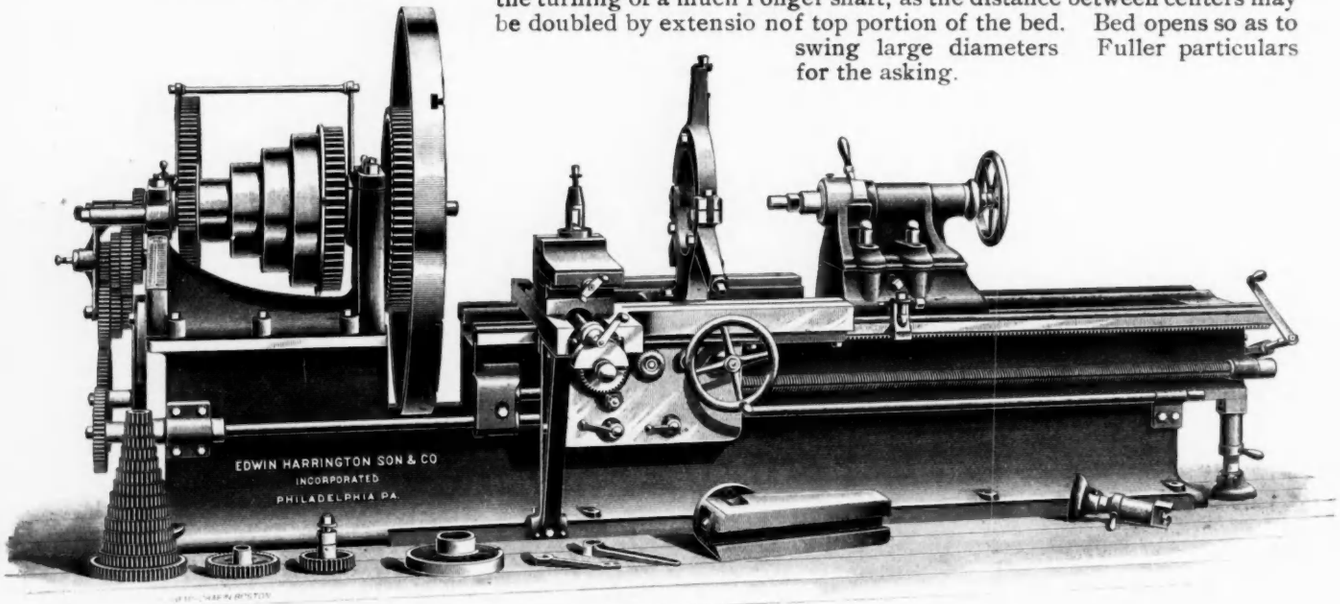

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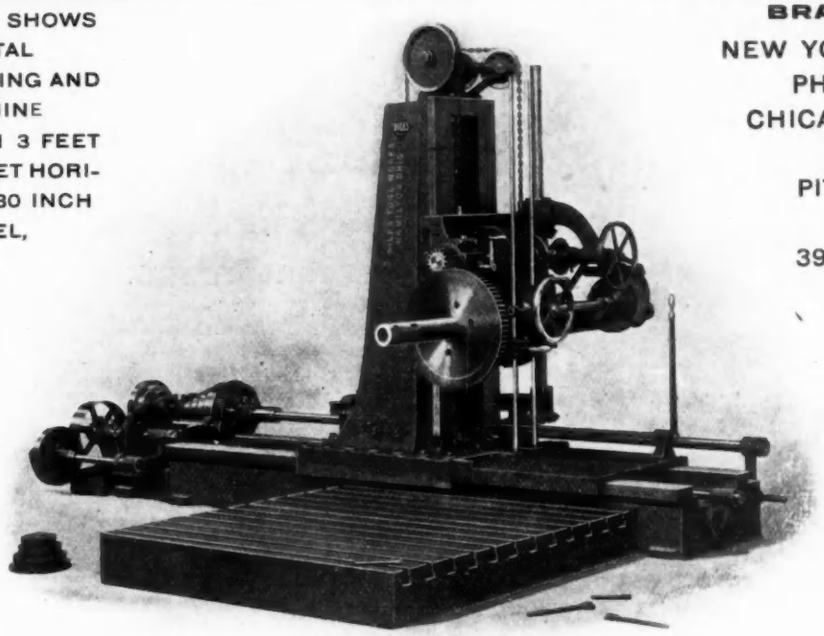

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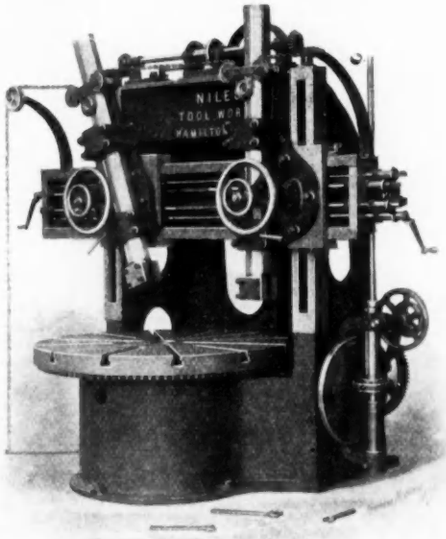

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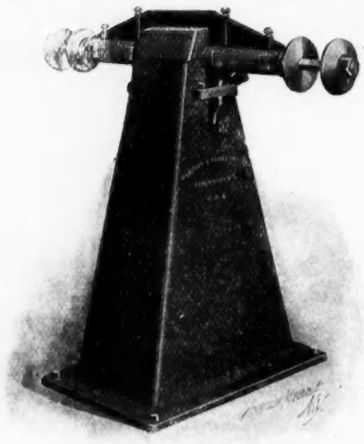

This machine may be belted from above or below; when from below, is provided with **covers** as shown, excluding **dust** and **lint**, and preventing such particles being carried by the belt to floor below.

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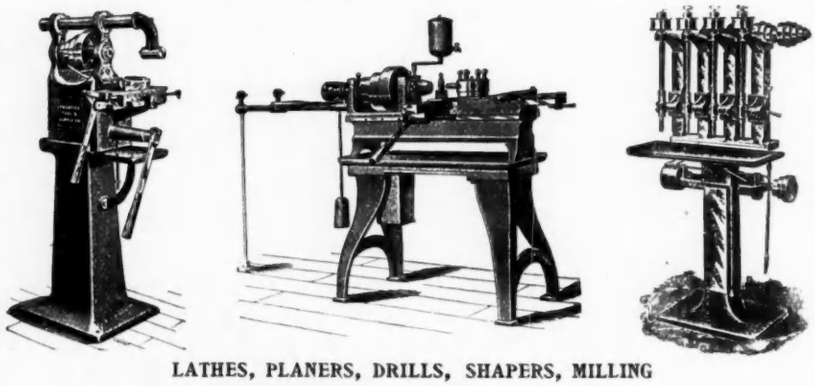

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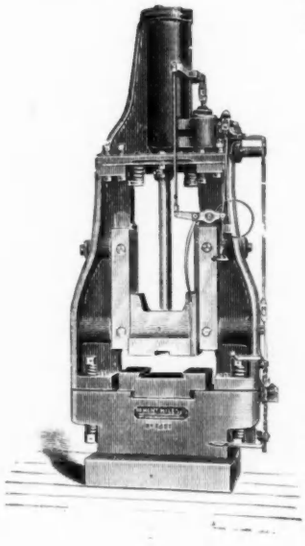

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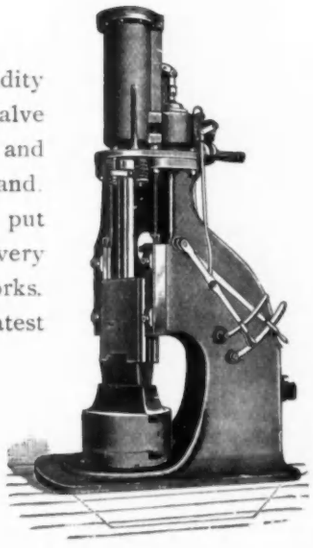

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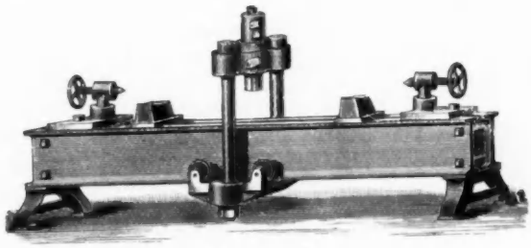

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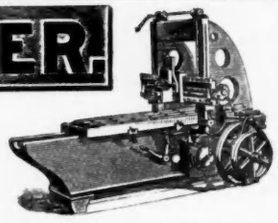

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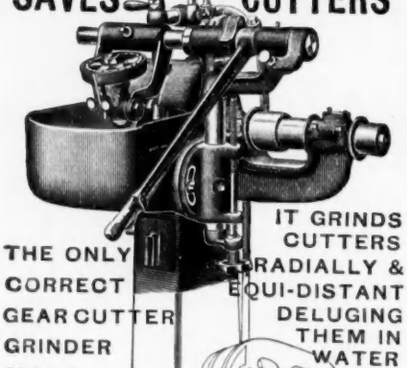

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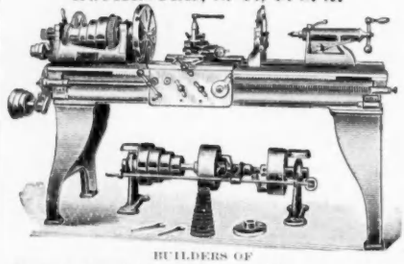

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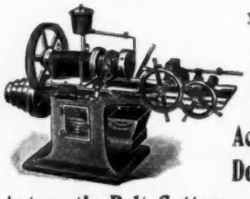

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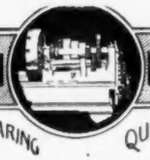

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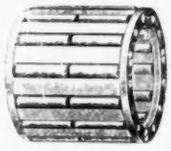

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